

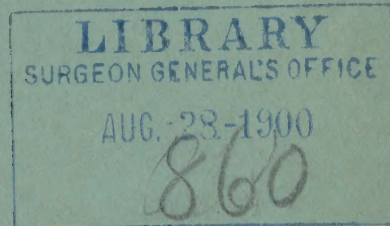
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INTERNAL PARASITES OF THE FUR SEAL.

BY
presented
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VII.—INTERNAL PARASITES OF THE FUR SEAL.¹

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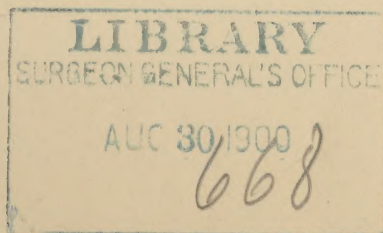
SUMMARY.

I.—Introduction: The first parasitic worms recorded from Bering Sea were collected by Steller in 1742 from the now extinct sea cow (p. 100). Since that time parasites (p. 100) have been mentioned from the fur seal of Bering Sea by Elliot, 1882, and by the British Commissioners in the Paris hearing, but the worms were not studied. The subject of the parasites of the fur seal bears an intimate relation to the parasites of marine mammals in general (p. 101), but references to the parasitic diseases of marine mammals are meager, and none of them treat the subject in detail (p. 101-102).

The parasitic worms collected by Lucas in Bering Sea came from the fur seal, the hair seal, and the sea lion (p. 102), and belong to three different families of worms (p. 103): mawworms of the genus *Ascaris*, strongyles of the genus *Uncinaria*, and tapeworms of the genus *Bothriocephalus*. Of these the ascarides and strongyles are the most important in connection with the subject at hand, and of mawworms alone we have sufficient material for proper study.

II.—Family Ascaridae (p. 103). Genus *Ascaris*: Synonymy (p. 103); diagnosis (p. 103). These worms occur normally in the digestive tract, but are occasionally found in other parts of the body (p. 104); a few specimens have little or no effect upon the host, but heavy infections may injure the hosts in various ways; by stoppage of the bowels, by wandering, taking food intended for host, wounding the mucosa, production of a toxic substance (p. 104). None of these effects have been observed in any degree of importance in the case of the fur seal, but there is no reason to assume that the effects of ascarides upon these animals will be different from the effects of mawworms upon other animals (p. 104). In our opinion, while the mawworms will undoubtedly be a factor in the general debility of seals in cases of excessive infections, the relation of the worms to the mortality of seals will be insignificant (p. 104). The seals become infected with their ascarides by eating fish; these worms accordingly play no rôle

¹ This report on the parasitic worms of the fur seal, collected by the United States Commission of 1896, was prepared under the direction of Dr. D. E. Salmon, Chief of the Bureau of Animal Industry, United States Department of Agriculture, at the request of the Secretary of the Treasury.



in the death rate of pups too young to catch fish, and a crowded condition of the rookeries is of no importance in connection with the spread of infection. There is evidently no way open to prevent infection. *Ascaris decipiens* was collected by Lucas from the fur seal, the hair seal, and the sea lion; and *A. osculata* from the sea lion (p. 105). These same worms are found in other parts of the world (Greenland, etc.) in other hosts.

The Ascarides of marine mammals.—Under this head we discuss the history of the subject, the division of the genus, and the history and structure of all of the various forms described.

III.—Family Strongylidae; (p. 164), subfamily Sclerostominae; genus *Uncinaria*.

A few worms of this genus were found by Lucas in a fur-seal pup, three months old, but our material is not sufficient to permit a detailed study of the form. The worms of this genus are blood suckers of the worst type, and a heavy infection would undoubtedly have very serious effects upon the pups, as allied worms do upon man, dogs, cats, and other animals. The life history of and source of infection by the seal *Uncinaria* is not demonstrated, and can not well be demonstrated at this distance from its habitat, but analogy would point at a direct development without an intermediate host. (See also Supplementary Note, p. 165.) If this view drawn from analogy is correct, the infection would take place upon the rookeries, and a crowding of the rookeries with an open season and lack of nourishment would give the conditions necessary for an epizootic; thus this worm might under conditions play an important rôle in the mortality of the pups, more especially if the latter were deprived of nourishment from their mothers because of pelagic sealing or other causes.

IV.—Family Bothriocephalidae (p. 167;) subfamily Bothriocephalinae; genus *Bothriocephalus*. A few worms of this genus were collected from the fur seal by Lucas who states that about 40 per cent of the seals are infected with them. Lack of time prevents our making a detailed study of the form. Analogy points to fish as the intermediate host, and hence as source of infection. These worms would accordingly not be found in young pups.

V.—Compendium of parasites arranged according to their hosts.

VI.—Bibliography.

I.—INTRODUCTION.

The earliest record we have been able to find of parasites in the marine mammals of Bering Sea is a statement by Steller (1751¹) that in July, 1742, he found some parasitic worms about half an inch long in the stomach of the now extinct sea cow, *Hydrodamalis Stelleri*. These helminthes (*Ascaris rytinae*, see p. 163,) are now unidentifiable, but have been referred to by various helminthologists.

In helminthological literature we have not succeeded in finding any further references to parasitic worms in Bering Sea, and especially of the fur seal, but Mr. Lucas has called our attention to the following passages in other works.

Elliot (1882,¹ p. 35) in his Monograph of the Sea Islands of Alaska, refers to worms in the stomach of the fur seal and the sea lion as follows:

I have examined the stomachs of hundreds which were driven up and killed immediately after their arrival in the spring near the village; I have the word of natives here, who have seen hundreds of thousands of them opened during the slaughtering seasons past, but in no one single case has

¹The dates enclosed in parentheses refer to the works cited in the bibliography, pp. 171-174.

anything ever been found other than the bile and ordinary secretions of healthy organs of this class, with the marked exception of finding in every one a snarl or cluster of worms (*Nematoda*) from the size of a walnut to a bunch as large as a man's fist. Fasting apparently has no effect upon the worms, for on the rare occasion, and perhaps the last one that will ever occur, of killing three or four hundred old bulls late in the fall to supply the natives with canoe skins, I was present, and again examined their paunches, finding the same *ascaridae* within. They were lively in these empty stomachs, and their presence, I think, gives some reason for the habit which the old bulls have (the others do not) of swallowing small water-worn bowlders, the stones in some of the stomachs weighing half a pound apiece; in others, much smaller. In one paunch I found over 5 pounds, in the aggregate, of large pebbles, which, in grinding against one another, I believe, must comfort the seal by aiding to destroy in a great measure those intestinal pests.

The sea lion is also troubled in the same way by a similar species of worms, and I preserved the stomach of one of these animals in which there was more than 10 pounds of stones, some of them alone very great in size. Of this latter animal, I suppose it could swallow bowlders that weigh 2 or 3 pounds each. I can ascribe no other cause for this habit among those animals than that given, as they are the highest type of the carnivora, eating fish as a regular means of subsistence, varying the monotony of this diet with occasional juicy fronds of seaweed or kelp, and perhaps a crab or such once in awhile, provided it is small and tender or soft-shelled. I know that the sailors say that the *Callorhinus* swallows stones to "ballast" himself; in other words, to enable him to dive deeply and quickly; but I noticed that the females and the "holluschickie" dive quicker and swim better than the old fellows above specified, and they do so without any ballast. They also have less muscular power, only a tithe of that which the "see-catch" possesses. No, the ballast theory is not tenable.

In the Report of the British Commissioners (p. 97, sec. 343) in the Paris Arbitration the following rather indefinite reference to the parasites of seals is found:

The fur seals upon the Pribilof Islands are, however, afflicted by at least one known trouble, that of intestinal worms, and in the stomachs of every seal killed a certain number, and often a very considerable number, of such worms are found. This can not, of course, be considered as constituting in itself a very serious affection, but if under any particular train of circumstances it should be considerably increased, it alone might become a danger to the continued well-being of the seals.

These, so far as we are aware, are the only published statements regarding the parasitic worms found in Bering Sea. The preliminary study of the parasitic diseases of the fur seal is thus reduced to indefinite and vague statements of little or no value. We may, however, expect that a review of the parasites of marine mammals will aid us in the subject at hand, as basis for comparison and inference, and it will be well, therefore, to take a glance at the literature upon this subject before passing to a determination of the worms collected by Lucas in Bering Sea.

The greater part of the literature upon the parasites of marine mammals is purely zoological, dealing with descriptions, lists, and synonymy of forms found in various parts of the world.

Both worms and arthropods have been found parasitic in or upon marine mammals. So far as the effect of animal parasites upon these hosts is concerned, the majority of helminthological articles do not refer to it. The following references to this subject have, however, been found:

Murie (1868) gives an account of a post-mortem examination upon a young male walrus which died at London. In this account, which is reprinted in full in connection with the parasite present (see p. 139), Murie found a large number of worms, *Ascaris bicolor* Baird, in the stomach, to the presence of which he attributed a congestion and ulceration of that organ. He also states that an abscess was found in the brain. In one portion of the account Murie says that "death seems to have resulted from the ulceration of the stomach," although he admits that "it is not clear why the animal should have succumbed so suddenly," and adds: "Literally speaking, these

ulcerations were so extensive that it is curious the animal should have survived so long." In another portion of his report Murie, in referring to the abscess of the brain, remarks: "Whether this lesion was the more immediate cause of death, and not the ulcerated condition of the stomach, is an open question."

Admitting that the ulcerated condition of the stomach was caused by the worms, and admitting that with "only the muscular and a very thin lining of the submucous tissue" remaining perforation might have easily occurred and been followed by a fatal peritonitis, we fail to see that Murie has made a clear case in diagnosing the cause of death.

Cobbold (1879) devotes a portion of his work on "Parasites" to a discussion of the animal parasites of Pinnipedia (Part V, pp. 313-315) and Cetacea (Part XI, pp. 416-430), from which the following passages are extracted:

Cobbold, 1879, page 418: The apparently healthy cetacean [*Phocaena communis* = *Phocaena phocaena*] was shot by Mr. Jardine Murray in the Firth of Forth in April, 1855. I mention its condition because the bile ducts were found to be diseased in a way similar to that ordinarily observed in cases of fluke rot affecting sheep, cattle, and other animals. In my MS. note book I remarked: "The liver ducts were in several places thickened and knotted near the surface of the organ. On opening these they were found to be loaded with small distomata" [*Distoma Campula* = *Campula oblonga*].

Cobbold, 1879, p. 422: * * * The small intestine of this porpoise [*Delphinus phocaena* = *Phocaena phocaena*] was completely choked for the space of 8 or 9 feet by fine tapeworms so closely packed together that the gut presented the appearance of a solid cylinder.

A most remarkable infection of a *Globicephalus Scineval* (= *Globicephala melas*) with thorn-headed worms (*Echinorhynchus capitatus*) was reported by Parona (1893), who estimated that 25,305 specimens were present in the intestine. Parona does not give a detailed account of the pathological effects of this infection, nor of any symptoms observed by the captors, but argues in favor of the view that a heavy infection like this one must have the same effect upon a wild animal as upon a domesticated animal.

These four citations are the most important references we have found dealing with the effects of parasitic worms upon marine mammals. It might, however, be added that the supposed genus *Conocephalus* (see *Ascaris typica*, p. 127) was based upon a coagulated body formed by mucus and epithelial cells from the stomach of the host; but the relation of the worms to any possible erosion of the stomach wall is not mentioned.

As it is impossible, in the time allotted to the preparation of this report, to discuss in detail all of the different parasites we find recorded for marine mammals, our discussion will be confined to forms directly bearing upon the parasites collected by Mr. Lucas.

THE PARASITIC WORMS COLLECTED BY LUCAS IN BERING SEA.

Mr. Lucas has furnished us with the following data concerning his examinations of marine mammals in Bering Sea during the summer of 1896:

Nematodes in varying numbers are always present in the stomach of the fur seal. There may be only two or three or there may be, roughly speaking, one hundred or more. Only in rare cases does their presence seem to cause any irritation, but occasionally a number may be found attached to one spot, and the stomach wall is there thick and hard.

An extreme case of this is shown in the specimen of stomach of sea lion, *Eumetopias*, but no case so bad as this was met with in any fur seal. The tapeworm is found in about two out of every five seals. Sometimes but one is present, sometimes ten or a dozen, though so many as this is rare.

The tapeworms are found in the large intestine, in the majority of cases with the head fastened in or near to the caecum, which, in the fur seal, is short.

No tapeworms were found in the two old males killed in August, which had not eaten for at least two months.

The worms collected by Lucas came from the fur seal (*Callorhinus ursinus*), the sea lion (*Eumetopias stelleri*) and the hair seal (*Phoca largha* Pallas).

A species of tapeworm (*Bothriocephalus*, see p. 168) was found in *Callorhinus*; a few strongyles (*Uncinaria*, see p. 165) were present in the intestine of a *Callorhinus* pup, and ascarides (*Ascaris*) were present in *Callorhinus*, *Eumetopias*, and *Phoca*. The ascarides alone were present in large numbers. As it is evidently these worms to which the British referred in the Paris report, and as these were the only worms present in sufficient numbers in 1896 to come into consideration from a medical point of view, furthermore as the time at our disposal for this report is exceedingly limited, almost the entire time allotted for study of the seal parasites has been given to studying the members of this genus.

II.—Family ASCARIDAE.

This family of round worms is variously diagnosed by different authors, but it must be subjected to a rigid and critical study, with modern methods, before we can tell with any degree of satisfaction which genera should be included in it and which should be eliminated from it. For generic diagnoses of the forms which come into question, Dujardin (1845), Diesing (1860), and Schneider (1866) especially should be consulted.

No attempt will be made in this report to define these various genera, as only one of them, the type of the family, comes into consideration in connection with the parasites of seals. It may, however, be remarked that the genus *Conocephalus* and probably also *Peritrachelius* fall as synonyms of *Ascaris*.

ASCARIS Linnaeus, 1758.

1758. *Ascaris* LINNAEUS, *Systema naturae*, 10th. ed., p. 648. Type by elimination, *A. lumbricoides* Linnaeus, 1758.

1800. *Capsularia* ZEDER, *Erster Nachtrag Naturg. Eingeweidew.*, pp. xl, 5, 7. Encysted larvae in *Salmo* and *Clupea*.

1800. *Fusaria* ZEDER, *Erster Nachtrag Naturg. Eingeweidew.*, pp. xl, 6, 16. *Ascaris* renamed and including *A. lumbricoides*, hence type, *A. lumbricoides*.

1845. *Ascaris (Ascaris)* DUJARDIN, *Hist. nat. Helminthes*, p. 154. Includes type of genus, hence type, *A. lumbricoides*.

1845. *Ascaris (Anisakis)* DUJARDIN, *Hist. nat. Helminthes*, p. 20. Type, "*A. simplex* Rudolphi," misdetermined = *A. Dussumierii*.

1860. *Conocephalus* DIESING, *Sitzungsber. k. Akad. Wiss. Wien*, XLII, no. 28, p. 669. Type, *Conocephalus typicus* Diesing, 1860.

DIAGNOSIS.—Body more or less elastic, elongate, cylindrical, more or less attenuated toward both extremities. Mouth anterior, terminal, with three terminal convergent lips, two of which are ventro-lateral, the third dorso-medial; armed pharyngeal bulb absent. Anus near posterior extremity. Sexes separate.

Male: With two spicules, ventral caudal papillae present; praeanal sucker absent.

Female: Vulva in anterior two-thirds of body.

Type: *Ascaris lumbricoides* Linnaeus, 1758.

¹No pretensions to a complete generic synonymy are here made. Only such genera and subgenera are cited which have a direct bearing upon the type species and those species considered in this paper. A complete revision of the nematodes must be made to establish complete generic synonymy.

Worms of this genus occur in the adult stage in the stomach and intestine of various animals. They are occasionally reported in other portions of the body, as the mouth, nasal passages, bile ducts, peritoneal cavity, etc. In many instances this aberrant position of the worms is undoubtedly due to an active wandering of the parasites after the death of the host, although cases are also recorded where the nematodes have been taken from other portions of the body than the stomach and intestine immediately after death. Cases are also recorded of expulsion of ascarides through the mouth or nose during the life of the host.

A few ascarides may occur in an animal and yet not have any serious effect upon it, especially if the host is large. When present in considerable numbers, however, they are undoubtedly of importance and may bring about serious trouble. The injury to the host may be of different kinds:

(1) By the presence of a large number of ascarides the lumen of the intestine may be so filled as to cause a temporary stoppage of the bowels.

(2) A wandering of ascarides from the intestine to the liver through the bile ducts, which rarely occurs, may interfere with the flow of the bile, and may even result in more serious complications.

(3) It is claimed by some that the ascarides may perforate the intestine, especially in case of intestinal ulceration, and thus gain access to the body cavity. An ingress of faecal matter through the perforation will result in peritonitis and thus lead to death. Such active perforation of the intestinal wall is, however, certainly rare.

(4) The assimilation of food by the ascarides results of course in depriving their hosts of a certain quantity of nourishment; but this will be insignificant in cases of light infections.

(5) Some ascarides have very strong lips and become firmly attached to the walls of the intestinal tract. It is but natural that numerous wounds in the mucosa arising from the lips and teeth of the worms should produce some injury, as they would form points of attack for bacteria. If Murie's opinion (see p. 139) is correct that the ulcers in the stomach of the walrus he examined were due to the presence of the ascarides found, these ulcers probably began in this way.

(6) It has been shown that some ascarides secrete a substance which produces a swelling around the eyes, a profuse flow of tears, and intense itching. This action on the part of the ascarides of seals does not seem to have been noticed as yet.

The above-known conditions are taken from ascaride infection of land animals. We know nothing of the effects of these parasites upon the seals; but we do not hesitate to assume from analogy that they will have practically the same effect upon seals which similar parasites have upon other animals. We do not, however, believe that they will enter into serious consideration in connection with the mortality of seals, since death from ascarid infection must be exceedingly rare.

It is generally assumed that ascarides are all autoecious parasites; that is, they have a direct development with only one host. While this point has been established for *A. lumbricoides* of man, it will be shown below that seals become infested by eating fish.

This fact has an important bearing upon the relation of these worms to the diseases of the seals, for although we may find ascarides in very young dogs and cats, the pups of seals will not become infected with them until they begin to eat fish. In other words, while the crowding on the rookeries would naturally present conditions

which would be most favorable to the development of parasitic diseases, such conditions in no way enter into the consideration of infection by the ascarides in question. The infection takes place in the water, not upon the land.

The maw worms collected in Bering Sea by Lucas have been referred to two species, both of which have already been recorded for other parts of the world. *Ascaris decipiens* was found in the material taken from the fur seal, the hair seal, and the sea lion, and *Ascaris osculata* in the material taken from the sea lion.

As these two species are considerably confused in helminthological works, not only with each other, but with still other forms, it has been necessary to consult the entire literature upon the ascarides of marine mammals; and as a knowledge of the characters of all these parasites is necessary in judging the forms found by Lucas, it has been decided to incorporate in this report their descriptions, hosts, and synonymy.

THE ASCARIDES OF MARINE MAMMALS.

According to Krabbe (1878), O. Fabricius (1780, p. 272—not accessible to us) mentioned three species of nematodes, namely *Ascaris phocae*, *A. bifida*, and *A. tubifera* from Greenland seals, but Krabbe states that none of these forms can be recognized. Goeze (1782, pp. 73, 74) described an *Ascaris phocarum* collected by Soemmering in 1781 from *Phoca vitulina*; the animals were $4\frac{1}{2}$ inches long and not quite a line thick. Gmelin (1790, p. 3030) cites *A. phocae*, to which he refers Goeze's *A. phocarum*; he also cited *A. bifida*; short diagnoses are given. Rudolphi (1793, p. 10) also refers to *A. phocae*, but does not add anything to the description.

The later history of these worms is intimately connected with the history of the genera *Rictularia* Froelich, *Ophiostoma* Rudolphi, and *Dacnitis* Dujardin. As so much uncertainty exists concerning the forms, and as they can not be properly judged without a careful study of the history of the genera in question, they will not be considered further in connection with this report.

The history of the ascarides of marine mammals, so far as species recognized to-day are concerned, begins with Rudolphi (1802), who described an *Ascaris osculata* from *Phoca*. Between the appearance of Rudolphi's article containing a description of this worm and the appearance in 1866 of Schneider's *Monographie der Nematoden*, authors pretended to recognize Rudolphi's species and to distinguish from it certain other species and genera described as new.

With Schneider (1866) a new epoch in nematode literature began. This author restudied Rudolphi's material, together with other specimens preserved in the Berlin Museum, and gave good descriptions and figures. Very unfortunately he failed to state in most cases whether the description of a given form was based directly upon Rudolphi's originals or upon other material, so that in many cases we are left in uncertainty regarding the weight which should be attached to his diagnoses of Rudolphi's forms. As Schneider definitely states, however, that he examined Rudolphi's originals, and as his work in reality represents the first extensive publication upon nematodes prepared in a manner to be of much service, we consider it obligatory upon us to accept his determinations as correct until they are proved to be erroneous. We consider all literature upon the subject of the nematode parasites of marine mammals published prior to 1866, and all determinations made before this date, except in so far as the specimens have since been reexamined, as open to question.

Since Schneider's monograph appeared, various authors have studied the nematode parasites of marine mammals; some of their articles are worthless, as they show a complete ignorance of the literature of the subject as well as superficial study of the worms. The most important studies upon the subject have been made by Krabbe (1878) and Jägerskiöld (1894), whose writings will frequently be referred to in the text of this report.

Before passing to a description of the worms to be studied, it will be necessary to consider for a moment the classification of the genus *Ascaris*.

Various attempts have been made to divide this genus into subgenera and sections. The divisions made by earlier authors, Rudolphi (1809), and de Blainville (1828) need hardly be considered here.

Dujardin (1845) proposed a division based upon anatomical characters, and this classification, although not generally accepted, should be given here because of its relation to some of the forms which occur in marine mammals. The following table shows the various groups proposed by Dujardin.

- I. Subgenus *Ascaris*: Uterus with two parallel branches extending caudad.
 1. Section: Oesophagus simple, with or without ventricle, but without pyloric (caecal) appendages. This section, with 54 species, included the type of the genus and *Ascaris osculata* Rudolphi (see p. 151).
 2. Section: Oesophagus followed by a more or less distinct ventricle, with oesophageal caecum, or with an intestinal pyloric appendage. Species Nos. 55 to 66, none of which are considered in the present report.
 3. Section: Oesophagus prolonged by a caecum or pyloric appendage at the side of the intestine, and accompanied also by another caecum from the intestine and directed cephalad. Species Nos. 67 to 71, none of which are considered in this report.
 4. Section: Oesophagus with a single caecum or pyloric appendage extending caudad at the side of the intestine. One species, *A. acus*.
- II. Subgenus *Ascaridia*: Uterus with two branches extending in opposite directions. Species Nos. 73 to 75, not considered in this report.
- III. Subgenus *Anisakis*: Male with two unequal specules. See *A. Dussumierii*, p. 161.
- IV. Subgenus *Poltydelphis*: Uterus divided into more than two branches. Type and only species, *A. anoura*.

Investigations since Dujardin's time seem to prove that this classification can not be accepted.

Schneider (1866) proposed to divide the genus *Ascaris* as follows:

- A. Lips with dentigerous ridge, but without intermediate lips.
- B. Lips with dentigerous ridge and with intermediate lips.
- C. Lips without dentigerous ridge, but with auriculæ and intermediate lips.
- D. Lips without dentigerous ridge, with "Löffeln" and intermediate lips.

The importance of the intermediate lips as a means of classification seems to be well established, and will be adopted in this report.

As stated above, a study of the ascarides collected by Lucas necessarily led to a study of all of the ascarides found in marine mammals, since it immediately seemed probable that the parasites from Bering Sea were closely allied to the forms collected from allied hosts from Greenland and Iceland. Unfortunately we have had very little material for comparison, and have not had time to obtain for consultation any of the types contained in the European collections.¹ Our determinations are therefore based entirely upon the diagnoses of other workers.

¹ See pp. 113, 126, 134, 142, 157.

The material we had on hand for comparison consisted of a few worms collected in Europe by Stiles and a few bottles found in the Leidy collection. Taking the characters from our own specimens and from the literature upon the subject, the following key has been prepared and will be of service in determining the known¹ ascarides of marine mammals.

KEY TO THE ASCARIDES OF MARINE MAMMALS.

1. Adult forms 2
 Larval forms which are not developed to a degree permitting the determination of the species;
 generally with prominent tooth ventral of mouth and with conical spine on the tail.
 *A. capsularia* (p. 164).
2. Intermediate lips absent 3
 Intermediate lips present 9
 No data at hand concerning intermediate lips 10
3. Dentigerous ridge present on lips 4
 One papilla on each ventro-lateral lip, said to bear 6 to 7 teeth; oesophageal and intestinal caeca
 apparently absent; second portion of oesophagus usually sigmoid.
 Male: 70 to 90^{mm} long; tail with 7 to 8 pairs of postanal papillae, of which 1 to 4 are near the
 tip, 5, 6 + 7, and 8 near the cloaca; left (2.3^{mm}) spicule longer than right (1.7^{mm}) spicule.
 Female: 80 to 100^{mm} long; vulva near the middle of the body.
 Host: *Delphinapterus leucas*. See also *A. simplex* (p. 121) *A. Kükenenthalii* (p. 144).
 Data concerning dentigerous ridge are wanting 8
4. Dentigerous ridge, single 5
 Dentigerous ridge, double; cuticular bands provided with fine transverse striae.
 Male: 28^{mm} long; caudal papillae numerous.
 Female: 57^{mm} long; vulva?
 Host: *Otaria jubata*; Patagonia *A. patagonica* (p. 143).
5. Cuticular bands with finer transverse striae; spicules nearly equal 6
 Cuticular bands without finer transverse striae, but arranged so as to give a serrate appear-
 ance to the margin of the worm when seen under the microscope; oesophageal and
 intestinal caeca absent 7
6. Lips of nearly equal diameter, but of very different outline; oesophageal caecum may be present or
 absent; intestinal caecum present, long or short.
 Male: 33 to 70^{mm} long; 5 to 6 pairs of praeanal papillae, of which 1, 2, 3 are conical and nearer
 the tip, 3 larger than 2, 2 larger than 1; 4, 5, 6 shorter and nearer the cloaca, 5 larger than
 4 or 6. About 60 pairs of praeanal papillae, increasing in size from first to eighth; spicules
 nearly equal, 1.5 to 2.5^{mm} long.
 Female: 25 to 80^{mm} long; vulva near middle of the body.
 Hosts: *Phoca*, *Cystophora*, *Odobenus*, *Halichocrus*, *Callorhinus*, *Eumetopias*; Arctic Ocean and
 Bering Sea *A. decipiens* (p. 109).
 Lips of nearly equal size (Krabbe), or dorsal lip (0.12^{mm}) much smaller than ventral (0.30^{mm})
 lip; oesophageal and intestinal caeca absent.
 Male: 37 to 130^{mm} long; 6 to 8 pairs of postanal papillae, of which 1 to 4 nearer the tip, the
 outer pair being longest; 5 to 8 are shorter and nearer the anus; praeanal papillae arranged
 each side in one or two rows, the first six pairs nearest the cloaca are shortly pedunculate;
 the others are longer; spicules 1.68^{mm} long.
 Female: 97 to 200^{mm} long; vulva a little in front of the middle of the body.
 Hosts: *Balaenoptera*, *Delphinapterus*, *Monodon*, *Hyperoodon*, *Lagenorhynchus*, *Otaria*, ? *Phocaena*,
 ? *Delphinus*, ? *Platanista*; Greenland, Iceland, Denmark, and elsewhere ... *A. simplex* (p. 120).

¹ *Heterocheilus tunicatus* found in *Manatus inunguis* and *Peritrachelius insignis* found in *Delphinus amazonicus* (= *Inia Geoffroyi*) are not considered in this key. From Drasche's studies it seems probable to us that *Peritrachelius*, type *P. insignis*, is a synonym of *Ascaris*, but we hesitate to suppress the genus at present without first examining specimens of it. *Heterocheilus* also may be an *Ascaris*, but we have no specimens for study. See footnote, p. 103.

7. Cuticular bands, 32 μ broad; dorsal lip divided into a large base, and a very small anterior bilobed projection; second portion of oesophagus generally sigmoid.
 Male: 31 to 70^{mm} long; with 9 to 10 (11) pairs of postanal papillae, of which 1, 2, 3 are conical and near the tip, 4 to 10 (11) shorter and nearer the cloaca; praeanal papillae numerous, arranged in three rows each side; left (3^{mm}) spicule about three times as long as right (0.96^{mm}) spicule.
 Female: 37 to 90^{mm} long; vulva near middle of the body.
 Hosts: *Delphinus* and *Prodelphinus*; Atlantic and Pacific oceans *A. typica* (p. 127).
 Cuticular bands 24 μ broad; lips not well studied, but apparently of nearly equal size.
 Male: unknown.
 Female: 62 to 75^{mm} long; of a dark brownish or white color.
 Host: *Odobenus rosmarus* *A. bicolor* Baird sp. inq. (p. 138).
8. Lips of nearly equal size; intestinal caecum present.
 Male: 85 to 115^{mm} long; one pair of postanal papillae, four pairs of praeanal papillae; spicules short.
 Female: 85 to 144^{mm} long; vulva one-third to two-thirds the length from anterior extremity.
 Host: *Dugong dugon* *A. halicoris* (p. 147).
 Host: Antarctic seal (genus? species?). Wings said to extend the whole length, becoming thicker at distal extremity. Worms 37 to 50^{mm}, of a dark olive color.
A. similis, sp. inq. (p. 146).
9. Cuticle immediately back of lips, in deep folds; posterior portion of oesophagus, including oesophageal caecum, between one-third and one-half as long as anterior portion; cuticular bands 8 μ broad, without finer striation.
 Male: 34 to 70^{mm} long; 8 to 10 pairs of postanal papillae, of which 1 to 4 are near the tip, and one pair of double papillae between these and cloaca; 30 or more pairs of praeanal papillae, arranged on each side irregularly or in a double row; spicules equal, 3 to 8^{mm} long.
 Female: 40 to 80^{mm} long; vulva on a prominent transverse ridge about one-third the length of the body from the head.
 Host: *Phoca*, *Halichoerus*, *Stenorhynchus*, *Eumetopias*; cosmopolitan *A. osculata* (p. 151).
 Posterior portion of oesophagus, with oesophageal caecum, scarcely one-sixth as long as anterior portion.
 Male: 40^{mm} long; 12 pairs of postanal papillae, of which 1 to 3 are near the tip, 4 to 12 irregularly arranged; praeanal papillae in a single row.
 Female: 50^{mm} long; vulva about one-fourth the length of the body from the head.
 Host: *Platanista gangetica*; Ganges *A. lobulata* (p. 159).
10. No details of structure known.
 Hosts: *Platanista* and the extinct *Hydrodamalis* 11
 First portion of oesophagus 5^{mm} long; second portion 1.5^{mm} long, sigmoid; cuticular bands 29 to 30 μ broad; head 0.4^{mm} broad; lips small.
 Male: 79^{mm} long, tail curled, caudal alae present with 8 to 10 papillae; spicules unequal (27:15).
 Female: 70 to 100^{mm} long, vulva 25 to 40^{mm} from anterior extremity.
 Host: Dolphin (gen. ? sp. ?), Indian Ocean *A. Dussumieri* (p. 161).

UNIDENTIFIABLE SPECIES.

11. Host: Dolphin of the Ganges (*Platanista gangetica*) near Calcutta. Length over an inch long *A. delphini* (p. 162).
 Host: Steller's extinct sea cow (*Hydrodamalis gigas*) Bering Sea. Length "half a foot" *A. rytinae* (p. 163).
- I. Intermediate lips absent.
 A. Dentigerous ridge present on lip.
 a. Dentigerous ridge simple.
 α Cuticle with broad cuticular bands, and narrow transverse striae; spicules of nearly equal length.

1. ASCARIS DECIPIENS Krabbe, 1878.

(Figs. 1-22.)

? 1853, *Ascaris similis* BAIRD, see p. 146.

1878, *Ascaris decipiens* KRABBE, Oversigt K. Danske Videnskab. Selskabs Forh., pp. 45-47, fig. 1; pl. I, fig. 3; résumé pp. 10-12.—JÄGERSKIÖLD, 1894, Zool. Jahrb., VII, pp. 452, 467-474, pls. xxv, fig. 14, xxvi, 26, xxviii, 40-41.—STOSSICH, 1896, Boll. Soc. adriat. Sci. nat. Trieste, XVII, p. 20.

? 1888, *Ascaris bulbosa* COBB, Jenaische Zeitschr. Naturw., XXIII, (n. F., XVI), 1, 8 Dec., 1888, pp. 59-64, pl. v, figs. 29-30.—COBB, 1889, Arch. f. Naturg., 55 Jhg., I, p. 150, pl. VII, figs. 7-8.

1894, "*Ascaris osculata* RUDOLPHI," misdet. in Coll. Leidy, see STILES & HASSALL, Veterinary Mag., I, 5, p. 340.

DIAGNOSIS.—Intermediate lips absent; lateral cervical alae absent; lips of nearly equal diameter, but with different outlines, with bilobed anterior projection, which is much more prominent on the dorsal than on the ventral lips, and armed in both on its inner surface with a denticerous ridge. Cervical papillae about 0.5 to 1^{mm} from the anterior extremity. Body attenuated more toward the anterior than toward the posterior extremity. Cuticle with 40 to 48 μ transverse cuticular bands, which are provided with much smaller (4 μ) striae. Oesophagus divided into two portions: oesophageal caecum may be distinct or incorporated in the second portion of the oesophagus; intestinal caecum present, may be short or long. Excretory pore median, anterior, between the ventral lips.

Male: 33 to 70^{mm} long, by 1 to 1.5^{mm} thick; tail with lateral alae, about 3^{mm} long; 5 to 6 pairs of postanal papillae divided into two groups; 1, 2, 3 near the tip of the conical tail, 3 larger than 2, 2 larger than 1; 4, 5, 6 nearer the cloaca, 5 larger than 4 or 6; about 60 pairs of praeanal papillae, arranged on each side in single or double row, increasing in size from first to eighth; spicules of nearly equal length, varying from 1.5 to 2.5^{mm} long.

Female: 25 to 80^{mm} long by 1 to 2^{mm} thick; vulva marked by a transverse ridge in the middle third of the body. Eggs spherical, 48 to 56 μ , segment to morula stage in the uterus.

Habitat: Stomach and intestine of marine mammals, larvae encysted in marine fish.

Hosts.	Locality.	Collector.	Authority.
<i>A. For adult.</i>			
<i>Callorhinus ursinus</i>	Bering Sea.....	Lucas, 1896.....	Stiles & Hassall, 1899, p. 113.
<i>Cystophora cristata</i>	Greenland.....	Olrik.....	Krabbe, 1878, p. 45.
<i>Erignathus barbatus</i>	Greenland.....	Vahl, Olrik, Pfaff.....	Krabbe, 1878, p. 45.
<i>Erignathus barbatus</i>	Spitzbergen.....	Kükenthal.....	Cobb, 1888, p. 64; 1889, p. 150. ¹
<i>Erignathus barbatus</i>	Specimens from Vienna Museum.....	.....	Stiles & Hassall, 1899, p. 113.
<i>Eumetopias stelleri</i>	Bering Sea.....	Lucas, 1896.....	Stiles & Hassall, 1899, p. 113.
<i>Halichoerus grypus</i>	Bohuslän.....	.....	Jägerskiöld, 1896, p. 467.
<i>Macrorhinus angustirostris</i>	(?).....	Chapman.....	Stiles & Hassall, 1899, p. 112.
<i>Odobenus rosmarus</i>	Greenland.....	Zimmer.....	Krabbe, 1878, p. 45.
<i>Phoca foetida</i>	Greenland.....	Pfaff.....	Krabbe, 1878, p. 45.
<i>Phoca groenlandica</i>	Greenland.....	Morch, Møller, Andersen, Pfaff.....	Krabbe, 1878, p. 45.
<i>Phoca groenlandica</i>	Specimens from Vienna Museum.....	.....	Stiles & Hassall, 1899, p. 113.
<i>Phoca largha</i>	Bering Sea.....	Lucas, 1896.....	Stiles & Hassall, 1899, p. 113.
<i>Phoca vitulina</i>	Greenland.....	Morch, Olrik, Pfaff.....	Krabbe, 1878, p. 45.
<i>Phoca vitulina</i>	Schleswig.....	.....	Krabbe, 1878, p. 45.
<i>Phoca vitulina</i>	Leipzig.....	Stiles.....	Stiles & Hassall, 1899, p. 113.
<i>Phoca vitulina</i>	Specimens from Vienna Museum.....	.....	Stiles & Hassall, 1899, p. 157.
Seal, gen. ? sp. ?	Faroe.....	Müller.....	Krabbe, 1878, p. 46.
Seal, gen. ? sp. ?	Iceland.....	Steincke.....	Krabbe, 1878, p. 46.
Seal, gen. ? sp. ?	Greenland.....	Andersen.....	Krabbe, 1878, p. 46.
<i>B. For larva.</i>			
<i>Gadus macrocephalus</i>	Bering Sea.....	Lucas, 1896.....	Stiles & Hassall, 1899, p. 119.
<i>Theragra chalcogramma</i>	Popoff Island.....	.....	Stiles & Hassall, 1899, p. 120.

¹ Recorded as *Ascaris bulbosa*. See p. 111.

SUMMARY.—The ascaride of the Alaskan fur seal is specifically indentical with an ascaride found in *Phoca largha* and *Eumetopias stelleri* in the same locality, and with the form described by Krabbe in 1878 as *Ascaris decipiens* from the stomach of *Phoca vitulina*, *P. groenlandica*, *P. hispida* (= *P. foetida*), *P. barbata* (= *Erignathus barbatus*), *Trichechus rosmarus* (= *Odobenus rosmarus*), *Cystophora cristata* and several undetermined marine mammals. The species from *Phoca barbata*, described by Cobb in 1888 as *Ascaris bulbosa*, does not appear to differ essentially from this form. Baird's (1853) *Ascaris similis*, from the stomach of an Antarctic seal (see p. 147), and his *Ascaris bicolor*, described in 1868 as parasitic in the stomach of *Trichechus rosmarus* (see p. 142), are possibly also identical with Krabbe's species. The parasite has a wide geographical distribution, and is

acquired by seals through eating fish. In detail the history of the worm is as follows:

HISTORICAL REVIEW.—Regarding *A. similis*, see page 147; for *A. bicolor*, see page 139.

Krabbe (1878, pp. 45–47, résumé, pp. 11, 12) described this species from material collected in Greenland by various persons (see p. 109) from *Phoca groenlandica*, *P. barbata* (= *Erignathus barbatus*), *P. hispida* (= *P. foetida*), *P. vitulina*, *Cystophora cristata*, and *Trichechus rosmarus* (= *Odobenus rosmarus*). Besides these hosts, from which the worms were collected, in all in seventeen cases, specimens were found three times in unnamed seals from Faroe (by Müller), Iceland (by Steineke), and Greenland (by Andersen). It was also found once in *Phoca vitulina* off the west coast of Schleswig. The parasite often occurs with *A. osculata* in the same host, and for both of these species the stomach is a more common habitat than the intestine. In one case a "couple of hundred" worms were present, of which one-third were males. The males attained 45^{mm} in length, the females 60^{mm}.

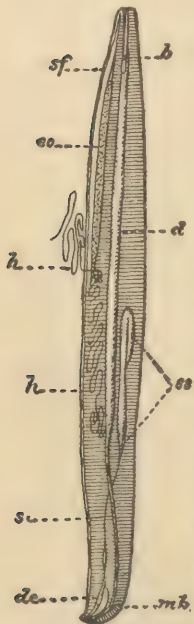


Fig. 3.

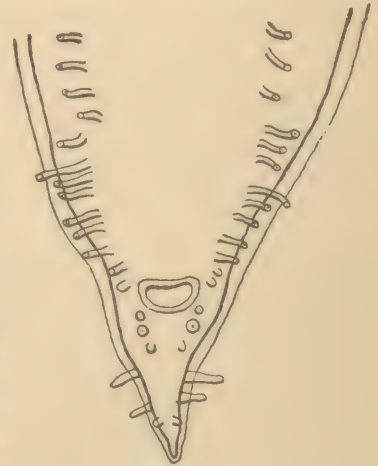


Fig. 2.

The lips are nearly alike, without intermediate lips; each lip bears (fig. 1) a broad, rounded anterior double lobe, separated from the basal portion of the lip by a lateral concave border. The inner surface of the margin of the anterior lobe is provided with a dentigerous ridge, arranged in a triply curved line. Of the six pairs of postanal papillae in the male (fig. 2) three pairs of conical papillae are near the tip, and increase in size from the tip forward, so that the third pair is the largest; nearer the anus are three pairs of smaller papillae; antero-lateral of the anus is situated on each side a row of conical papillae, which increase in size from the first to the seventh or eighth.

Krabbe was not able to definitely determine whether or not this form was identical with *A. maritima*, but Leuckart, who examined *A. decipiens* at Krabbe's request, stated that it was specifically distinct from *A. maritima*. The two forms belong to the same group, but there seems to be no evidence in support of the view that *A. maritima* of man occurs in seals.

Cobb (1888, pp. 59-64) described as a new species *A. bulbosa*, some nematodes taken by Kükenthal from the stomach of *Phoca barbata* (= *Erignathus barbatus*); although certain important details of structure are omitted in Cobb's article, there can be scarcely any doubt regarding the specific identity of his form with *A. decipiens*, as is shown by the following abstract of Cobb's work:

The male (figs. 3, 4) measures 50 to 70^{mm} long, with cylindrical body attenuated anteriorly; the head is about 0.33^{mm} broad, while the breadth of the body is one-twenty-fifth to one-twenty-sixth of its length. The transverse striae can be seen only with the aid of the microscope. The tail is curved and possesses papillae (fig. 4) which can be distinguished with the hand lens. Cobb's figure shows 7 pairs of postanal papillae; 1, 2, and 3 nearer the tip, 4, 5+6, and 7 nearer the cloaca; praeanal papillae about 60 in number on each side, extending forward in two irregular rows; in the figure the first five praeanal papillae are smaller than those which follow; the spicules measure 2 to 2.5^{mm} long, are nearly similar, but the left spicule (2.5^{mm}) is slightly longer than the right (2.3^{mm}). The female measures 50 to 80^{mm}, the vulva is situated somewhat more than one-third the length of the body from the anterior extremity. The 3.3^{mm} long oesophagus is composed of three portions: an anterior portion 2^{mm} long by 0.5^{mm} in diameter (broadest portion); a second bulb-like portion 0.33^{mm}, and terminal cylindrical portion 1^{mm} long by 0.33^{mm} broad. The intestine possesses a proximal caecum. The excretory organ opens between the ventro-lateral lips.

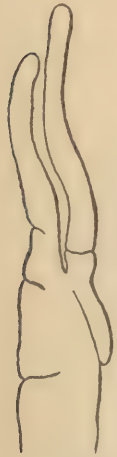


Fig. 5.

The vagina measures 2 to 3^{mm} long; the uterus, including the horns, 15 to 16^{mm}; eggs develop to the morula stage in the uterus. The cervical papillae are situated 0.5^{mm} back of the mouth. From the fact that the excretory organ opens between the ventral lips, intermediate lips must be absent.

In his second paper Cobb (1889, p. 150) gives a short abstract of his first article.

Jägerskiöld (1894, pp. 452, 467-474) determined as identical with *A. decipiens* parasites preserved in the Zoological Institute of the Upsala University and taken from the mouth and pharynx of *Halichoerus grypus* Nilsson. From his anatomical discussion the following data are abstracted.

The oesophagus is divided into two portions: The anterior portion agrees essentially with the corresponding portion of the oesophagus in "*A. simplex*" as

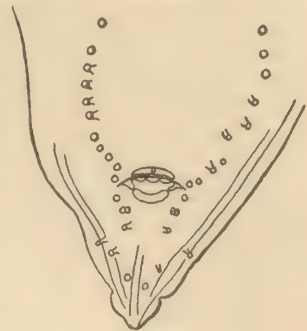


Fig. 4.

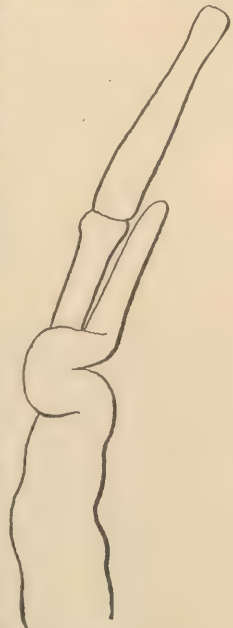
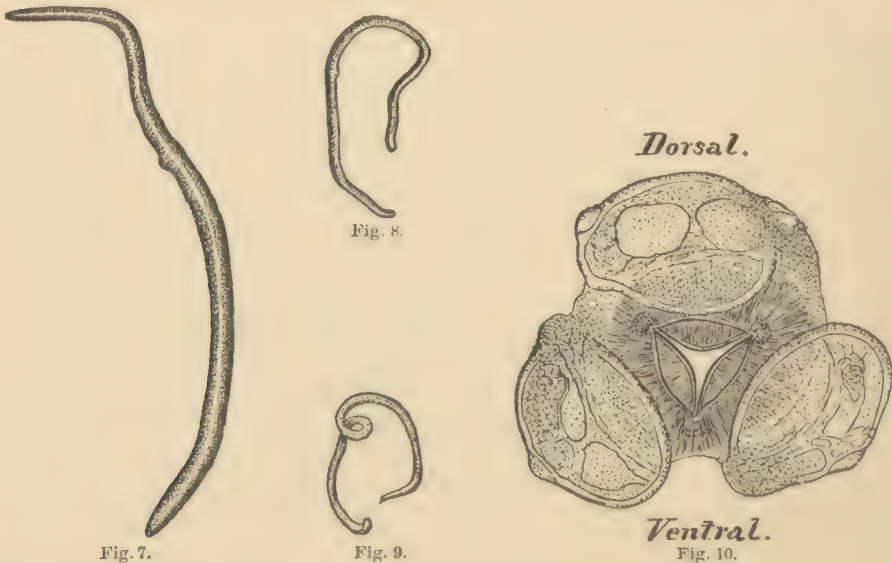


Fig. 6.

defined by Krabbe; the second portion is shorter than the first, and may be united with the intestine in two different manners; either the dorsal surface of the oesophagus may be united with the ventral surface of the intestine, thus leaving the distal portion of the second part of the oesophagus and the proximal portion of the intestine as two caeca (fig. 5), or the distal end of the oesophagus may be united with the intestine in such a way that the intestinal caecum is present, the oesophageal caecum on the other hand, absent (fig. 6). The excretory organ is developed in the same peculiar manner as in *A. osculata* and *A. spiculigera*, but discharges between ventral lips, while in *A. osculata* and *A. spiculigera* it discharges distally of the intermediate lip; the gland extends beyond the middle of the body. The vulva is situated about in the middle of the body, or somewhat distal to the middle. "The vagina, which first runs cephalad for about 5^{mm} and then turns, becomes widened into the uterus a few millimeters back



of the turning point; about 6^{mm} back of the foremost point of the vagina, that is, immediately distal of the vulva, the uterus branches into two horns 8^{mm} long."

Jägerskiöld calls attention to the resemblance which *A. bulbosa* Cobb bears to this form; he believes they are identical, but owing to the lack of certain details regarding the lips of Cobb's form, he reserves definite judgment upon the case.

The observations by Krabbe, Cobb, and Jägerskiöld seem to be the only original work upon *A. decipiens* which has been published, and in this connection it must be recalled that the specific identity of the worms described by Baird and Cobb, with the parasites discussed by Krabbe and Jägerskiöld is probable, but not absolutely established; furthermore, that Rudolphi's (1809) original *A. simplex* may possibly belong to this species rather than to *A. angulivalris* (see p. 124).

Stiles and Hassall (1894, p. 340) catalogued specimens found in the Leidy collection (No. 259=U.S.N.M., No. 5051), collected by Dr. Chapman from *Macrorhinus angustirostris*, and determined as *Ascaris osculata*. An examination of this material

shows that the worms agree in essential characters with *A. decipiens*. There are also a few unrecorded female specimens of the same species in the Stiles collection (U.S.N.M., No. 5341), taken from *Phoca vitulina*, at Leipzig, in July, 1890; the origin of the host is not noted on the label.

After this manuscript was ready for press we received a sending of parasites from Dr. von Marenzeller, of the Vienna Museum. The labels do not give the history of the specimens, but an examination of the material has resulted in the following determinations:

B. A. I., No. 2829, contains several young specimens, labeled *Ascaris decipiens*. No host is given. There are no males present, but we believe the determination to be correct.

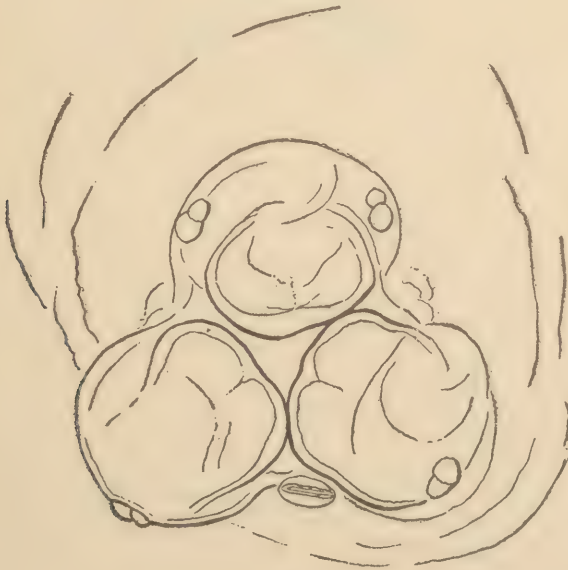


Fig. 11.

One bottle with the label "*Ascaris osculata*, *Phoca barbata*," contains both *Ascaris decipiens* (B. A. I., No. 2841), and *A. osculata* (B. A. I., No. 2831). One bottle, with the label "*Ascaris osculata*, *Phoca groenlandica*," contains both *Ascaris decipiens*, (B. A. I., No. 2843) and *A. osculata* (B. A. I., No. 2835).

SPECIMENS FROM BERING SEA.—Among the parasites collected by Lucas, from the Alaskan fur seal, *Phoca largha* and *Eumetopias stelleri*, we find quite a number of ascarides (figs. 7-9) which agree in essential characters with *A. decipiens*, as diagnosed by Krabbe. The worms represent various stages of development, from larval forms 14^{mm} long by 0.5^{mm} broad, described below, to adults 80^{mm} long by 2^{mm} in diameter.

Adults.—The head of the adult is about 0.46^{mm} broad in an average specimen, but varies, of course, with the size and development of the worm. Intermediate lips are absent, as shown by transverse sections (fig. 10) and other views (figs. 11-14). Transverse sections show that the bases of the lips are of nearly equal size; dorsal and

ventral views (figs. 12, 13), however, show that the outline of the dorsal lip is somewhat different from that of the ventral lips. The dorsal lip has a large base 0.27^{mm} broad by 0.128^{mm} long, which bears the usual pair of sense papillae, one on each antero-lateral margin; it bears also an anterior double-lobed projection 0.144^{mm} broad by $80\ \mu$ long, the measurements varying somewhat in different specimens; a dentigerous ridge is present on the inner surface of the anterior projection; the ventro-lateral lips are essentially of the same differentiation, namely, a large base with a smaller double-lobed anterior projection, but in the ventral lips the base is longer, and the anterior projection extends more into the space between the three lips, so that



Fig. 12.

the lobes are somewhat concealed; on apex view (fig. 14) and on transverse section (fig. 15), however, these lobes are plainly visible; they are provided with an inner dentigerous ridge; the basal portion of each ventral lip is provided with the usual sense papilla. The excretory pore (figs. 11, 14) opens in the median line between the ventral lips, immediately ventral to the apex of the oesophageal triangle.

Cervical alae are absent; cervical papillae are plainly visible about 1^{mm} from the anterior extremity.

The cuticle of the body is provided with 40 to 48 μ transverse bands, which are provided with a much finer striation.

Our examination of the oesophagus of the Bering Sea form gives the same results which Jägerskiöld obtained in studying parasites of the same species taken from *Halichoerus grypus*. Figs. 16, 17 bring out this point very clearly, so that it is scarcely necessary to repeat the description, although it may be remarked that the intestinal caecum may be long or short, in some cases so short as to appear almost absent, while it is usually concave on the surface which rests upon the oesophagus.

The adult males (fig. 9) vary from 33 to 63^{mm} in length by 1 to 1.5^{mm} in diameter; the body is slightly more attenuated toward the anterior than toward the posterior extremity; the latter (fig. 18) is curled ventrally; it appears somewhat flattened

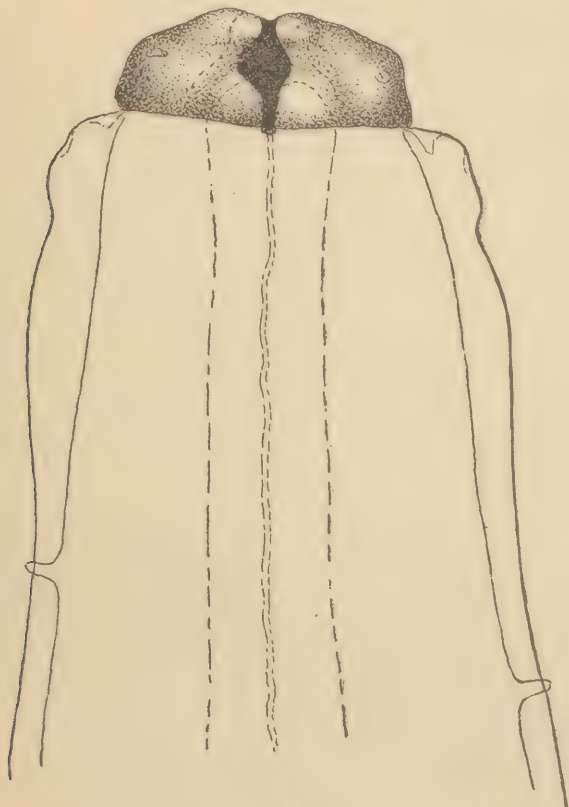


Fig. 13.



Fig. 14.

dorso-ventrally, and upon closer study is seen to possess a rounded keel-like dorsal ridge, with lateral alae which are curled ventrally, giving the ventral surface a concave spoon-like appearance. Numerous caudal papillae (figs. 18, 19) are present. The six pairs of postanal papillae (fig. 19) are divided into two groups; 1, 2, and 3 are nearer the tip of the conical tail and increase in size so that 2 is larger than 1, and 3 larger than 2; occasionally one or another of these papillae are absent; 4, 5, and 6 are nearer the cloaca, and of these 5 is larger than 4 or 6. The praeanal papillae are arranged in a single or double row each side, and increase in size from the cloaca to a short distance in front (about praeanal No. 7 or 8), the papillae farther forward being slightly smaller. The spicules are nearly equal in size, 1.5^{mm} long.

The adult females vary in length from 25 to 75^{mm}, with a diameter of 1 to 2^{mm}. The body is attenuated more toward the head than toward the tail. The vulva is found in the middle third of the body, generally near the middle: in a specimen 65^{mm} long it was 27^{mm} from the anterior extremity. In the same specimen the vagina

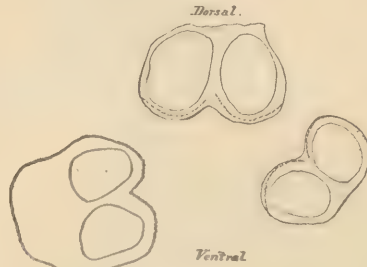


Fig. 15.

measures 5^{mm} long, the body of the uterus 12^{mm}, the horns of the uterus 18^{mm}. The eggs are spherical, 48 to 56 μ in diameter, and reach the morula stage in the uterus.

Immature stage.—Among the nematodes taken from the stomach of seals are to be found a number of smaller worms, which upon closer examination proved to be young specimens of *Ascaris*. Similar worms were found also in Leidy's collection

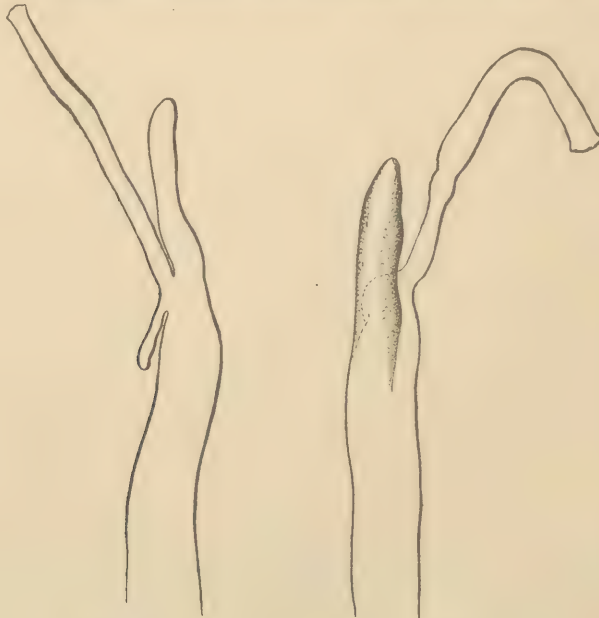


Fig. 16.

Fig. 17.

in association with *A. typica*. These parasites agree in a general way with the descriptions given of *A. capsularia*, and we have no hesitation in considering them the immature stage of the adult worms with which they are associated. This is by no means intended to imply that all specimens recorded by various authors as "*A. capsularia*" are the young forms of *A. decipiens* or *A. typica*. On the contrary,

A. capsularia is probably a collective designation, including the young stages of a number of distinct species of *Ascaris*, and would thus from a biological standpoint nearly correspond to such expressions as *Agamodistomum*, *Cysticercus*, etc.

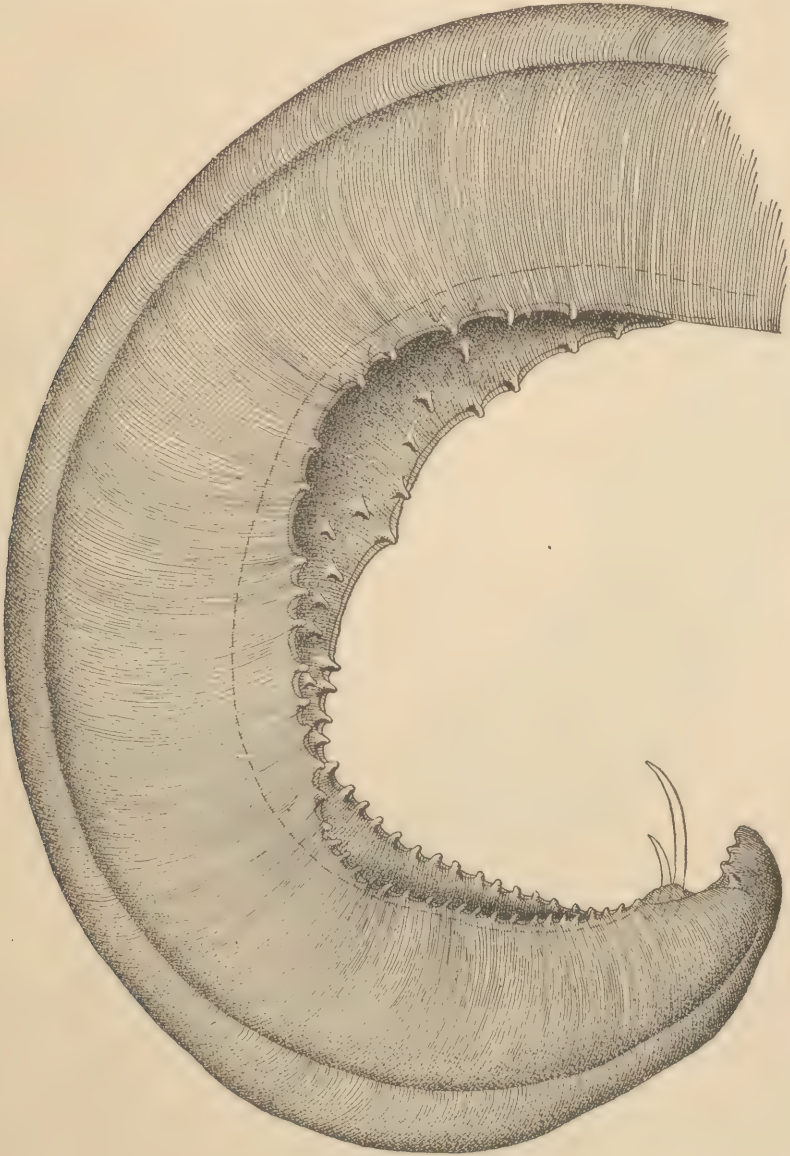


Fig. 18.

The young stages (figs. 20-22) in the fur seal attained 14^{mm} or more in length by about 0.528^{mm} in diameter, and possessed a finely traversely striated cuticle. The head is provided with a well-developed spine, ventral of the round mouth, and four papillae; in some specimens the cuticle was being cast, and within it the three

characteristic lips were then visible. A small, conical spine, about $20\ \mu$ long, is also present on the tip of the tail; this spine is finely striated transversely and is curved ventrally or dorsally. Of internal organs, the intestinal tract is well developed; the oesophagus is divided into an anterior portion about 1.8mm long and a posterior portion about 0.8mm long; in younger specimens (fig. 20) in which the oral tooth was present, the oesophageal and intestinal caeca were absent, but in specimens which had shed the oral tooth the intestinal caecum was present, the intestine and rectum were distinct. From lack of time the other internal organs were not studied carefully.

Von Linstow (1878, pp. 237, 238) described a young nematode from the muscles of *Osmerus eperlanus* under the name *Ascaris eperlani*. These worms measure 23.4mm long by 0.72mm broad: the oral tooth is absent, but the three lips are present; the intestinal caecum is also present. "*Nematoideum salmonis eperlani* Rud." is given

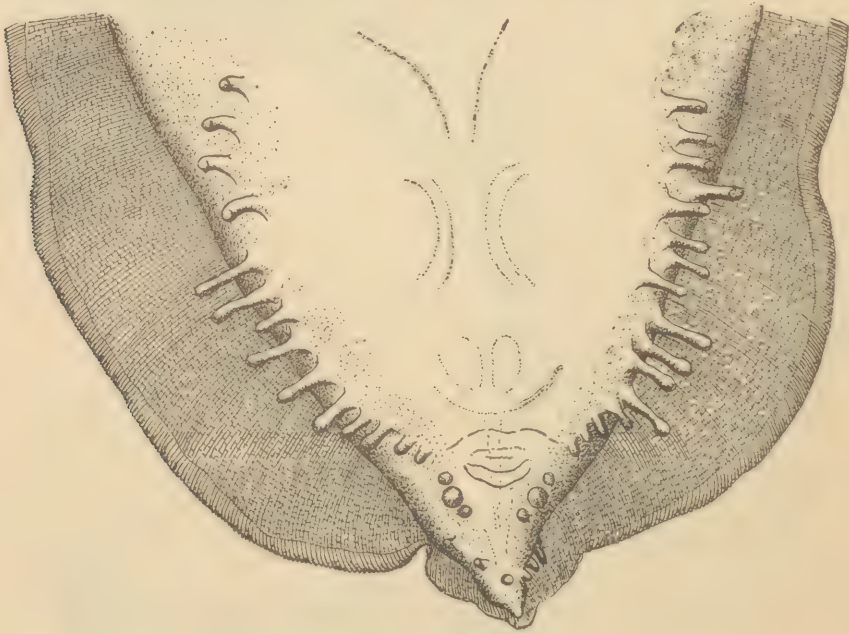


Fig. 19.

as a synonym, and *Agamonema bicolor* Diesing is mentioned as the embryonic form. This latter worm von Linstow also found in *Osmerus eperlanus*: it measured 8.8mm long by 0.23mm broad, the oral tooth was present, and the intestinal caecum was well developed. Later von Linstow (1895, pp. 519-524) describes *Ascaris eperlani* more in detail and suggests that it represents the larval stage of *Ascaris decipiens*. *Agamonema bicolor* was first described as *Filaria bicolor* Creplin, and is reported from "*Perca fluviatilis*, *Acerina vulgaris*, *Osmerus eperlanus*, *Lota communis*, and *Gasterosteus fluviatilis*."

Von Linstow may be correct in his supposition that the worms known as *Agamonema bicolor* (*Filaria bicolor*), *Nematoideum salmonis eperlani* and *Ascaris eperlani* represent the younger stages of *A. decipiens*, in which case the five fish just mentioned would form intermediate hosts, but our experience with the earlier determinations

of nematodes has been such that we are inclined to suspend judgment upon them all until the originals have been restudied. (See *Ascaris capsularia*, p. 164.)

Source of Infection.—From the facts that ascarides corresponding to the so-called *A. capsularia* are present in the seal's stomach, and that all intermediate stages between these young forms and the adults are found, it is clear that the seal becomes infected with *A. decipiens* by eating fish. According to the reports of those who have studied the question, the food of the fur seal consists mainly of surface swimming fishes and of squid. The Alaskan pollock (*Pollachius chalcogrammus* =

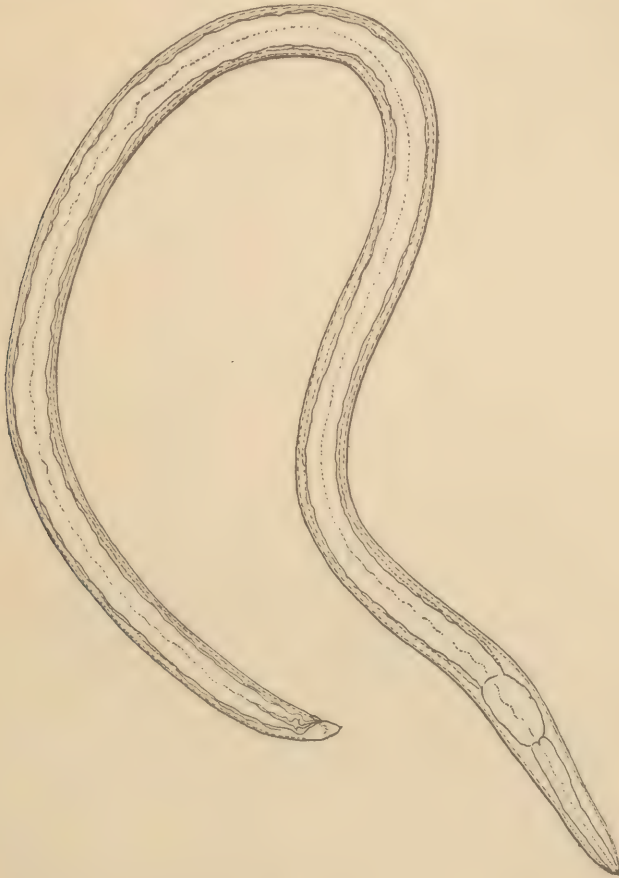


Fig. 20.

Theragra chalcogramma), a species of red rockfish (*Sebastes*), a squid (*Gonatus amoenus*) are the forms most frequently eaten; salmon and other fishes are occasionally taken.

Numerous encysted specimens (U. S. N. M., No. 2821) of "*A. capsularia*" were found in a specimen of Pacific cod (*Gadus macrocephalus*) collected by Lucas in Bering Sea. We have been unable to recognize any differences between these larval worms and the youngest forms found in the stomach of the seal. At the same time we have not been able to distinguish the lips clearly in this form, and on that account it is

impossible to state definitely whether these larvae represent the young of *A. decipiens* or *A. osculata*. Mr. Lucas informs us that the seal occasionally, though rarely, eats this species of cod, which is a deep swimmer and almost too agile for the seal, but from the general structure of the worm, and from the fact that the seal does occasionally eat this food, we are inclined to look upon it as one of the sources of infection of the seal ascarid.

The chief source of infection is probably the Alaskan pollock (*Theragra chalcogramma*). In a specimen of this species taken off Popoff Island, which we owe to the kindness of Mr. Barton Bean, of the U. S. National Museum, we have found encysted nematodes which also agree essentially with the so-called "*Ascaris capsularia*," and with the youngest forms found in the seal's stomach.

We have, of course, not been able to make any direct infections, so that this view that the Alaskan pollock and the Pacific cod form the intermediate hosts for *Ascaris decipiens* is not absolutely demonstrated, but taking into consideration the similarity of the encysted worms with the youngest worms found in the seal, and



Fig. 21.



Fig. 22.

the fact that the seal feeds upon these fish, the probabilities in favor of the view border upon a certainty.

From the probable fact that the seals thus obtain their ascarid parasites from their regular food, and from the fact that we are dealing in both cases with wild and marine animals, it will be seen that nothing can be done to prevent infection.

2. ASCARIS SIMPLEX Rudolphi, 1809, det. Krabbe, 1878.

Figures 23-29.

? 1804, *Ascaris simplex* RUDOLPHI, Bemerkungen, etc., p. 94. Nomen nudum.

? 1809, *Ascaris simplex* RUDOLPHI, Entozoonum hist. nat., II, n. p. 170.—RUDOLPHI, 1819, Entozoonum synopsis, p. 49.—DIESING, 1851, Systema helminthum, II, p. 155.—VAN BENEDEN, 1870, Bull. Acad. roy. Belgique, 2 ser., XXIX, 363.—COBBOLD, 1876, Proc. Zool. Soc. London, p. 297.—COBBOLD, 1876, Journ. Linn. Soc. London, Zool., XIII, No. 65, Sept. 19, 1876, pp. 42-43.—COBBOLD, 1879, Parasites, p. 426.—COBBOLD, 1886, Linn. Soc. Journ., XIX, pp. 176-177.—MONTICELLI, 1889, Boll. Soc. Naturalisti Napoli, III, pp. 69-70.

? 1819, *Ascaris delphini* RUDOLPHI, see p. 162.

- 1851, *Ascaris angulivalvis* CREPLIN, Arch. f. Naturg., 17 Jhg., I, pp. 158-160.—DIESING, 1860, Sitzungsber. k. Akad. Wiss. Wien, XLII, No. 28, pp. 656-657.
- 1878, *Ascaris simplex* RUDOLPHI, of KRABBE, Oversigt k. Danske Videnskab. Selskab Forhandl., 1878, 1, pp. 47-49, fig. 2, pl. I, fig. 4, résumé, p. 12.—VON LINSTOW, 1888, Report H. M. S. *Challenger*, Zool., XXIII, part LXXI, pp. 2-3, pl. I, figs. 1-4.—BRAUN (1891), Arch. d. Fr. d. Naturg. i. M., p. 110.—JÄGERSKIÖLD (1891), Biol. Fören. Förhandl., Stockholm, III, No. 7, p. 132.—JÄGERSKIÖLD, 1894, Zool. Jahrb., VII, pp. 474-476, pl. XXVIII, fig. 42.—STOSSICH, 1896, Boll. Soc. adriatica Sci. nat., XVII, p. 17.
- † 1889, *Ascaris Kükenenthalii* COBB, see p. 144.

DIAGNOSIS.—Intermediate lips absent; lateral cervical alae absent; lips of nearly equal size (Krabbe), or (von Linstow) dorsal lip (0.12^{mm}) smaller than ventro-lateral lips (0.30^{mm}); lips with two anterior lobes, constricted from the base, and armed on their inner surface with a denticigerous ridge; cervical papillae. Body attenuated more toward the anterior than toward the posterior end. Cuticular bands 23 μ broad, with finer striae about one-eighth as broad; lateral lines 0.23 μ broad, dorsal and ventral lines 35 μ . Oesophagus composed of two portions; anterior portion increases gradually in diameter; posterior portion begins with a swelling and then decreases; caeca absent.

Male: 37 to 130^{mm} long by 0.9 to 2.5^{mm} in diameter; tail with lateral alae about 2.5^{mm} long; 6 to 8 pairs of postanal papillae; of these, 4 pairs are near the tip, the outer pair being the longest; the other 2 or 3 pairs are shorter and nearer the anus; 50 or more (pairs?) praeanal papillae; of these, 6 pairs of shortly pedunculate papillae lie antero-lateral of the cloaca; then follows cephalad on each side one row of long papillae, or two rows which are closely approximate; spicules long (1.68^{mm}), with saber-like curvature (Linstow).

Female: 79 to 200^{mm} long by 2.2 to 2.75^{mm} thick; vulva three-sevenths the length from the anterior end (Linstow), about one-half (36:72 and 70:150) the length from the anterior end (Jägerskiöld). Eggs spherical, 52 μ with roundish elevations.

Habitat: Stomach of marine mammals.

Host.	Locality.	Collector.	Authority.
<i>Balaenoptera rostrata</i>		Koren	Creplin, 1857, pp. 158-160. ¹
<i>Balaenoptera rostrata</i>		Koren	Krabbe, 1878, p. 12.
<i>Balaenoptera rostrata</i>			Jägerskiöld, 1894, p. 475.
<i>Balaenoptera sibbaldii</i>	Specimens from Sparre	Schneider of Tromsø	Jägerskiöld, 1894, p. 475.
<i>Delphinapterus leucas</i>	Greenland	Olrik, Pfaff, Andersen	Krabbe, 1878, p. 48.
<i>Delphinapterus leucas</i>	Specimens from Levinsen of Copenhagen.		Jägerskiöld, 1894, p. 475.
<i>Delphinus</i> sp.....	Patagonia.....	Chierchia.....	Monticelli, 1889, p. 69.
<i>Hyperoodon rostratus</i>	Faroe.....	Suenson.....	Krabbe, 1878, p. 48.
<i>Lagenorhynchus albirostris</i>	Denmark.....	Ibsen, Reinhart.....	Krabbe, 1878, p. 48.
<i>Monodon monoceros</i>	Greenland.....	Olrik, Pfaff.....	Krabbe, 1878, p. 48.
<i>Monodon monoceros</i>	Specimens from Steenstrup.		Diesing, 1860, p. 657.
<i>Otaria jubata</i>	Kerguelen Islands.....	Challenger expedition	Linstow, 1888, p. 2.
<i>Phocaena phocaena</i> ²			Krabbe, 1878, p. 48.
<i>Phocaena phocaena</i> ²		Albers.....	Rudolphi, 1809, p. 170.
<i>Platanista gangetica</i> ²		Anderson.....	Cobbold, 1876, p. 297.
Porpoise, gen.? sp.? ²	Chiloe Island.....	Darwin, 1835.....	Cobbold, 1886, p. 176.

¹ Recorded as *Ascaris angulivalvis*.

² In need of verification, see p. 124.

SUMMARY.—Our first exact statements regarding this species we owe to Krabbe (1878), who determined certain worms from toothed whales as *Ascaris simplex* Rudolphi, and upon examination of material collected by Koren, a part of which was described by Creplin (1851) as *A. angulivalvis*, determined the latter form as identical with the former. We have at present absolutely no exact knowledge of the forms determined as *A. simplex* prior to the appearance of Krabbe's work, and some of the later determinations are exceedingly doubtful. The exact status of *A. delphini*, quoted by most authors as a synonym of *A. simplex*, can not be ascertained (see p. 162), but further investigation

may show that *A. Kükenthalii* Cobb (see p. 144) is synonymous with the form now under discussion. In detail the history of *A. simplex* is as follows:

HISTORICAL REVIEW.—Rudolphi's (1809, p. 170) original diagnosis reads as follows:

35. *Ascaris simplex* R.

Ascaris: Capite tenuiore caudaque teretibus obtusis.

Hab.: In *Delphini Phocaenae* ventriculo primo ab am. Albers magna copia reperta, et mecum communicata.

Descr.: Vermes pollicem vel sesquipollicem longi, crassiusculi, albidi, spiraliter convoluti.

Caput obtusum, trivalve, valvulis exiguis. Corpus undique teres, utrinque, autorsum tamen magis attenuatum. Cauda obtusa. Membrana linearis nullibi conspicua.

(Obs.: Inter specimina plurima vix unum alterumve possideo, ejus entis vel in antica vel in postica parte in processum pellucidum et vacuum protracta non sit, ut *Ascaride* obiter spectata mox caput mox cauda vacua appareat. Nil nisi emphysema post mortem obortum, eutem laxiorem tamen indicans, alias enim haec in crenas potius abiisset.

Later Rudolphi (1819, p. 49) adds:

Asc. capite nudo, corpore retrosum crassiore, cauda obtusa. * * * An huc n. 82?

N. 82, to which he refers, is *Ascaris delphini*, cited by Rudolphi (1819, pp. 54, 296) as having been collected by Lebeck in *Delphinus gangeticus* (= *Platanista gangetica*). There is, however, nothing in Lebeck's citation of the worm which warrants the assumption that his form was *Ascaris simplex*, and although nearly all authors consider it a synonym of that species, and on this ground give *A. simplex* as one of the parasites of *Platanista gangetica*, it seems to us much more logical to dispose of the doubtful species *A. delphini* by making it a doubtful synonym of *Ascaris lobulata*, which is described from the same host species (*P. gangetica*), or by ignoring it entirely. (See p. 162.)

Regarding the worms which Dujardin (1845, pp. 220, 221) determined as *Ascaris simplex* Rudolphi some difference of opinion exists among authors. Diesing (1851, p. 155) and Stossich (1896, p. 17) accept the determination as correct, while van Beneden (1870, p. 362) considers that these parasites represent a distinct species *A. Dussumierii*; von Linstow (1888, p. 3) even doubts whether the Dujardin's worms belong to the genus *Ascaris*. The host was a dolphin, taken near the Maldives in 1830. (See p. 161.)

Creplin (1851, pp. 158, 160) described under the name *Ascaris angulivalvis* three specimens of nematodes taken from *Balaena rostrata* (= *Balaenoptera rostrata*); the worms were given to him by Oskar Schmidt, who received them in 1850 from Mr. Koren, of Bergen. One of the specimens was deposited in the Zoological Museum in Greifswald. More exact data concerning the origin of specimens were not published. Creplin was unable to utilize Rudolphi's diagnosis of *A. simplex* in trying to determine his own specimens, since the description was so poor, but he considered his parasite closely related to, yet perfectly distinct from, the worms which Dujardin determined as *A. simplex*. Creplin's description reads as follows:

Die drei oben erwähnten Specimina bestanden in einem—dem Anschein nach—erwachsenen Paare und einem jüngeren Weibchen. Sie waren sämtlich schmutzig grau von Farbe. Das Männchen des Paares war ungefähr $2\frac{3}{4}$ '' lang und in der Mitte $1\frac{1}{4}$ '' dick, das Weibchen desselben etwa $3\frac{1}{4}$ '' lang und in der Mitte $1\frac{3}{4}$ '' dick. Das jüngere Weibchen hatte eine Länge von 2'' und eine mittlere Dicke von c. $\frac{3}{4}$ '''. Beide Geschlechter waren nach vorn ein wenig mehr, als nach hinten, verschmälert; von Seitenmembranen fehlte hier, wie bei Rudolphi's und Dujardin's Species, jede Spur.

Die Mundklappen waren mittelmässig gross, eckig, mit einer nach aussen stark vorspringenden Ecke, und mit schief von hinten nach vorn abgestutzter Endspitze.

Des Männchens Schwanztheil war von auffallender Bildung, auf eine $1\frac{1}{4}$ '' lange Strecke, vom Ende ab gerechnet, nämlich leicht einwärts gekrümmt und von der Bauchseite daneben der Länge nach tief ausgehöhlt; die Ränder dieser Höhlung waren dick-wulstig und convergirten, so wie sich der Schwanztheil ein wenig verschmälerte, nach hinten, traten aber am letzten, sehr stumpfen Ende des Schwanztheils aus einander und liessen hier, ganz dicht vor der stumpfen Spitze zwischen sich ein ganz kurzes, borstenförmiges Penis-Spiculum heraustreten, und zwar nicht aus der Mitte ihres Zwischenraumes, sondern ein wenig nach der einen Seite hin. Wie in anderen Askariden-Männchen ist jedoch auch in diesem kein einfacher Penis zu erwarten, und das hier vermisste Spiculum lag daher ohne Zweifel nur neben dem hervorgeschobenen versteckt. Einem Afters ward ich nicht ansichtig. Auf der Rückenseite des Wurms zog sich, dem eingekrümmten Schwanztheil entlang, so weit sich unten die Aushöhlung erstreckte, zwischen den Wulsträndern eine hohe, übergerundete Carina, wie ein dritter, höherer, dicker Wulst, zum Schwanzende hinab. Die seitlichen Wülste waren stark querverrunzelt und gestreift, und dieser ganze, so eigenthümlich gebildete Schwanztheil zeigte ein äusser straffes und rigides Ansehen. (Dujardin giebt von den Männchen seiner "*Ascaris simplex* Rud." an, dass der eingekrümmte Hintertheil an der Bauchseite zwei membranöse, durch 8-10 Papillen gestützte Flügel besitze. Von solchen war hier keine Spur zu sehen).

Von dem Weibchen habe ich wenig zu bemerken. Der Körper ging hinten dick und abgestumpft, ohne Verschmähigung des Endtheils, aus. Der After stand, wenn ich nicht irre, an der Unterseite der stumpfen Endspitze. Die Vulva ward mir nicht sichtbar; sie befand sich vermuthlich an einer Stelle des Körpers welche durch Druck und Quetschung gelitten hatte, dergl. sich an diesem, wie an dem jüngeren Weibchen hier und da fanden, bei welchem letztern ich denn die Vulva ebenfalls vergebens suchte.

Character speciei

Ascaris angulivalvis m.

Ascaris utrinque, sed antrorsum magis, attenuata, nuda, valvulis oris mediocribus, in angulem acutum utroque protractis, cauda maris incurva, infra excavata, supra carinata, feminae recta, obtusissima.

Hab.: Specimina nobis adducta in *Balaena rostrata* a cel Koren reperta erant.
Greifswald, den 5. März 1851.

Diesing (1851, p. 155) adds no new facts to our knowledge of *A. simplex*; he accepts *A. delphini* Rudolphi and Dujardin's specimens (= *A. Dussumierii*) as identical with this species. In his publication (1860, pp. 656-657) he accepted *A. angulivalvis* as distinct from *A. simplex*. To a condensed diagnosis of the former, based upon Creplin's description, he adds:

Specimina plura feminea Musci zootomici Hafniensis e *Monodonte Monocrota* lecta, a cl. Steenstrup benevole communicata, probabiliter ab hac specie vix diversa.

Van Beneden (1870, p. 363) had evidently not seen *Ascaris simplex*; he cites it as a parasite of *Phocaena communis* (= *P. phocaena*) simply stating "Ce ver est signalé dans l'estomac du marsouin par Rudolphi, Synopsis 54 et 296." This bibliographic citation refers to "*Ascaris delphini* Rudolphi," collected by Lebeck, but as van Beneden mentions this form elsewhere (1870, p. 359) as *A. delphini*, an error must be assumed in his bibliographic references. As he does not mention *A. simplex* in any other species of *Phocaena*, nor in any species of *Delphinus*, his citation of the presence of this worm in "*Phocaena communis*" (= *P. phocaena*) must refer to Alber's original collection from *Delphinus phocaena* (= *Phocaena phocaena*), and his bibliographic reference should read Rudolphi, Synopsis, p. 48.

Cobbold (1876, p. 297) examined four female ascarides collected by Dr. John Anderson from the intestine of the dolphin of the Ganges (*Platanista gangetica*), the

largest of which measured $1\frac{3}{4}$ inches long: "they presented the peculiarly flexed state of the chylous intestine or stomach, as described by Dujardin." Cobbold determined the worms as "characteristic specimens" of *A. simplex* Rudolphi, and states that "*A. delphini* of Rudolphi" must clearly be regarded as identical with this species.

Regarding Cobbold's statements, it may be remarked that they were made two years before Krabbe determined what a "characteristic specimen" of *A. simplex* was, and also, as his later articles show, he did not clearly understand the history of *A. delphini*. His determinations, therefore, are worthless. Cobbold (1876^b, p. 12) refers again to the specimens collected by Anderson, and states they correspond to *A. simplex* of Dujardin.

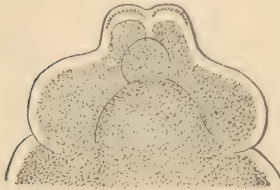


Fig. 23.

Krabbe (1878, p. 47-49, résumé, p. 12) referred to *A. simplex* all the ascarides found in the toothed whales from the coast of Denmark, Faroe, and Greenland, namely, in two specimens of *Lagenorhynchus albirostris* from Denmark, in seven specimens of *Beluga leucas* (= *Delphinapterus leucas*) from Greenland, in one specimen of *Hyperoodon rostratus* from Faroe, and in three specimens of *Monodon monoceros*

from Greenland. He also had some young specimens of *Ascaris* from *Phocaena communis* (= *P. phocaena*), but he could not definitely state that they belonged to *A. simplex*. In one *Beluga leucas* 177 specimens were taken, about one-third of which were males; the males measured 130^{mm}, the females 200^{mm}. This form (*A. simplex*) belonged to Schneider's Group A (intermediate lips absent, labial dentigerous ridge present). The lips were of nearly equal size; each bore anteriorly two lobes (fig. 23), which were constricted from the base and armed on their inner surface with a row of small teeth; on the end of the tail of the male (fig. 24) there were four pairs of conical papillae, of which the outermost was longest; between these and the cloaca were found two short papillae, occasionally apparently united in a double papillae; on each side antero-lateral of the cloaca were six short papillae, then followed on each side one row of long papillae or two rows which were closely approximate. Krabbe obtained from Koren specimens of the worm which Creplin had described from *Balaenoptera rostrata* as *Ascaris angulivalvis*, but was unable to notice any specific differences between these and the form he (Krabbe) had determined as *A. simplex*.



Fig. 24.

The following year Cobbold (1879, p. 426) reverts to the species *A. simplex*, but has decidedly confused the history of the worms he discusses. He states that *A. simplex* was originally found in the dolphin of the Ganges, and later by Albers in the common porpoise; he admits *A. Dussumierii* as distinct from *A. simplex*, but claims that "Lebeck's *A. delphini*" is identical with the latter species: yet the worms from the dolphin of the Ganges which he (Cobbold) examined and determined according to

Dujardin's description (= *A. Dussumierii*) he still retains under the name "*A. simplex*." In a later publication Cobbold (1886, pp. 176, 177) mentions some ascarides which Charles Darwin collected "from stomach of a porpoise off the island of Chiloe, January, 1835." There were thirteen specimens, mostly females, the longest of which did not exceed 3 inches. These Cobbold determined as "*A. simplex*," again stating that *A. delphini* found by Lebeck belonged to the same species; this view he "confirmed from an examination of nematodes procured from a *Platanista gangetica* by Dr. John Anderson," and he thinks "it probable that the *Ascaris* found by Krefit and Masters in a dolphin captured in Port Jackson is of the same species. If so, the worm occurs in *Delphinus phocaena*, in *D. Forsteri*, and in *Platanista gangetica*, and probably in the dolphins generally. * * * The ova from Mr. Darwin's specimens are nearly spherical, furnished with thin, transparent chorional envelopes. They give an average diameter of $\frac{1}{650}$ of an inch from pole to pole. M. Dujardin, whose description of the species is the best on record, found the eggs to be a trifle longer." In his bibliography of this worm Cobbold does not cite Krabbe's paper.



Fig. 25.

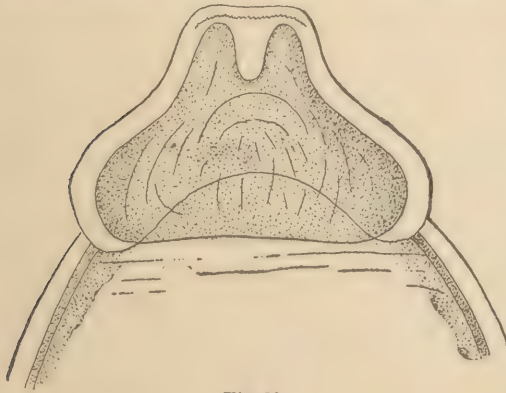


Fig. 26.

It is evident from Cobbold's discussion that at no time had he any clear idea of the worms he was attempting to describe; and all of his statements concerning them should be either preceded with a prominent mark of interrogation or rejected *in toto*.

Leidy (1886, p. 311) next recorded "*Ascaris simplex* Rudolphi from the stomach of a dolphin, *Lagenorhynchus*?" Pacific

ocean," but as we show on page 134 of this report, his specimens belong to *Ascaris typica*.

Von Linstow (1888, pp. 2, 3) appears to be the next zoologist to examine *A. simplex*. He records it "from the stomach of *Otaria jubata*, January 27, 1874, Kerguelen Island," collected by the *Challenger* expedition. Thirteen specimens (fig. 25) were taken, the largest measuring 79^{mm} long and 2.2^{mm} broad. The dorsal lip (fig. 26) is described as semicircular, with an anterior protrusion; the pulp sends two cylindrical protrusions into the latter, and these are rounded off anteriorly; the anterior end bears a denticerous ridge with pointed teeth; accessory lips wanting; dorsal lip (fig. 27) (0.12^{mm} broad) smaller than ventro-lateral lips (0.30^{mm}). The cuticle exhibits cuticular bands 23 μ broad, with finer striae about eight times as narrow; lateral lines 0.23^{mm} broad, dorsal and ventral lines 35 μ . The male measures 37 by 0.9^{mm}; its tail is provided with four [pairs] of conical papillae on extremity, two or three others of round form "just in front of the cloaca," at each side of these six other shortly stalked papillae, and again in front an inconstant row of fifty or more; cirri long (1.68^{mm}) with saber-shaped curvature. The female attains 79^{mm} in length by 2.2^{mm} in breadth; anus

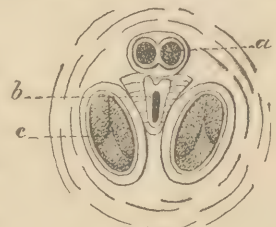


Fig. 27.

0.48^{mm} from the tip, which is rounded and bears a small styliform process embedded in the cuticle; vulva three-sevenths of the length from anterior extremity. The ova (fig. 28) are spherical, 52 μ in diameter, with roundish elevations.

Von Linstow does not believe that Dujardin's (1845) "*Ascaris simplex* Rud." (see *A. Dussumierii*) is identical with the species he studied.



Fig. 28.

Monticelli (1889, pp. 69, 70) records *A. simplex* from the stomach of "*Delphinus* sp., of Porto La gunas (*canali Patagonici*)," taken by Captain Chierchia in the voyage of the royal corvette *Vettor Pisani*. His determination was made by comparing the specimens with the worms (N. 529, 829) at the Vienna Museum determined by Diesing. It will thus be seen that this record depends entirely upon a determination made before Krabbe definitely defined *Ascaris simplex*, and on this account calls for confirmation.

Braun (1891, p. 110) and Jägerskiöld (1891) are not accessible to us at present.

Jägerskiöld (1894, pp. 474-476) examined specimens of *A. simplex* from *Beluga leucas* (*Delphinapterus leucas*), which he had obtained from Levensen: he found the bursa as well developed in these as in *A. angulivalvis* Creplin from *Balaenoptera rostrata*, and no longer doubts the identity of the two forms. He describes the oesophagus (fig. 29) as composed of two portions, an anterior longer portion, which increases gradually in diameter, and a second shorter portion, which begins with a swelling and then gradually decreases in size; no caeca are present. The intestine is provided with several rows of groups of elongate cells, each group having a V shape, the apex directed caudad. The excretory organ is about one-third as long as the animal. The vulva was 36^{mm} from the anterior end in a specimen 72^{mm} long, and 70^{mm} from the anterior end in one 150^{mm} long, these measurements thus differing considerably from those given by von Linstow (1888). The vagina is long and narrow, the uterus bicorn. Jägerskiöld inclines decidedly to the opinion that *A. Kükenenthalii* Cobb, from *Beluga leucas* (= *Delphinapterus leucas*) is identical with *A. simplex* as defined by Krabbe, but, being unable to examine specimens of Cobb's species, he reserves positive judgment.



Fig. 29.

Stossich (1896, p. 17) adds no new facts to our knowledge of *A. simplex*. He considers *A. delphini* and *A. Dussumierii*, as well as *A. angulivalvis*, as synonyms, but gives *A. Kükenenthalii* as a distinct species.

Regarding *A. Kükenenthalii* see p. 144.

Since finishing this manuscript we have received from Dr. von Marenzeller, of the Vienna Museum, a bottle of specimens with the label "*Ascaris simplex*, *Delphinus phocaena*." These worms we have redetermined as *Ascaris typica* (B. A. I., No. 2828). The label does not show whether these parasites were determined by Diesing or not.

β . Cuticular bands do not exhibit the finer transverse striae, but give a serrate appearance to the margin of the worm when viewed under a microscope; oesophageal and intestinal caeca absent.

3. *ASCARIS TYPICA* (Diesing, 1860) Jägerskiöld, 1894.

(Figs. 30-51.)

- ♀ 1845, "*Ascaris simplex* RUDOLPHI, 1809," of DUJURDIN, see p. 161.
 1860, *Conocephalus typicus* DIESING, Sitzungsber. k. Akad. Wiss. Wien, XLII. No. 28, p. 669.—VON LINSTOW, Compendium: d. Helminthologie, p. 59.—CARUS, 1863, in Peters, Carus & Gerstaecker, Handbuch der Zoologie, II, p. 462.
 ♀ 1870, *Ascaris Dussumierii* BENEDEN, see p. 161.
 1878, *Ascaris conocephalus* KRABBE, Oversigt K. Danske Videnskab. Selskabs Forhand., I, pp. 49-51, fig. 3, pl. I, fig. 5, résumé p. 12.
 1889, "*Ascaris conocephala* KRABBE," in VON LINSTOW, Compendium: Nachtrag, pp. 25, 26.—STOSSICH, 1896, Boll. Soc. adriatica Sci. nat. Trieste, XVII, pp. 17-18.
 1883, *Peritrachelius typicus* (DIESING, 1860) VON DRASCHE, Verhandl. k. k. zool.-bot. Gesellsch. Wien, XXXIII, pp. 109-111, pl. III, figs. 1-9.
 1886, "*Ascaris simplex* RUDOLPHI," misdetermined, LEIDY, Proc. Acad. Nat. Sci. Phila., p. 311.
 1894, *Ascaris (Peritrachelius) typicus* (DIESING, 1860) JÄGERSKIÖLD, Zool. Jahrb., VII, p. 453.

DIAGNOSIS.—Intermediate lips absent; lateral cervical alae absent; lips with very different outline and with denticerous ridge; dorsal lip with basal portion 0.16 to 0.2^{mm} broad by 80 to 88 μ long, which is divided into two large lateral lobes, bearing in its median line a prominent anterior double-lobed projection 48 μ long by 48 to 64 μ broad; the latter contains on each side a lobe of parenchyma and on its inner surface a denticerous ridge; the lateral lobes bear laterally what appears to be a very delicate denticerous ridge, but what is evidently a striation; ventro-lateral lips with large, almost semicircular basal portion 0.16^{mm} broad, bearing on the inner surface of the anterior portion a partially concealed double-lobed projection provided with a denticerous ridge; they bear laterally also what appears to be a very delicate denticerous ridge, which resolves itself into a striation; cervical papillae 0.66^{mm} from anterior extremity. Body attenuate more toward anterior than toward posterior extremity, which ends conically. Cuticle with cuticular bands 32 μ broad, but apparently without finer striae. Oesophagus composed of two portions: anterior portion 4^{mm} long by about 0.3 to 0.4^{mm} in diameter at distal end; posterior portion 1.25^{mm} long by 0.25^{mm} in diameter, generally sigmoid; oesophageal and intestinal caeca absent.

Male: 31 to 70^{mm} long by 1 to 1.5^{mm} in diameter; tail compressed dorso-ventrally with dorsal median rounded keel and with lateral alae. It is curved ventrally and bears numerous papillae; 9 to 10 (occasionally 11) pairs of postanal papillae, of which 1, 2, 3 are conical and near the tip; 4 to 10 (11) shorter and nearer the cloaca; 3 and 9, 10, 11 may occasionally be wanting; more than 75 praeanal papillae each side, arranged in three rows; those nearer the cloaca smaller and more irregularly arranged; cloaca 0.27^{mm} from tip of tail; spicules unequal, left spicule (3^{mm}) about three times as long as right spicule (0.96^{mm}).

Female: 37 to 90^{mm} long by 1.5 to 2^{mm} in diameter; vulva in middle third (generally near middle) of the body. Eggs globular, 46 to 56 μ , segment to morula stage in the uterus.

Types: Diesing's types in Vienna Museum; Krabbe's types in Copenhagen Museum. Typical specimens (Stiles & Hassall det.) in Coll. Leidy (U.S.N.M. No. 5015); from which specimens will be distributed as follows: U.S.N.M. No. 2813; Coll. B. A. I. (U.S.N.M. No. 2812); Coll. Stiles (U.S.N.M. No. 5456); South Kensington Museum, London; Berlin Museum; Coll. R. Blanchard, Paris; Copenhagen Museum; Vienna Museum.

Habitat: Stomach of marine mammals.

Hosts.	Locality.	Collection.	Authority.
<i>Delphinus (delphis)</i>	Atlantic Ocean	Hygom.....	Diesing, 1860, p. 669.
<i>Delphinus</i> sp.....	Pacific Ocean.....	W. H. Jones.....	Stiles & Hassall, 1899, p. 132.
<i>Phocaena phocaena</i>	Specimens from Vi- enna Museum.	.....	Stiles & Hassall, 1899, p. 134.
<i>Prodelphinus</i>	Atlantic Ocean.....	Andrea.....	Krabbe, 1878, p. 49.
<i>Dolphins</i> gen.? sp.?.....	Atlantic Ocean.....	Hygom, Iverson, An- drea.	Krabbe, 1878, p. 49.

SUMMARY.—*A. typica* (Diesing) belongs to Dujardin's subgenus *Anisakis* (type, *A. Dussumierii*). It was described in 1860 by Diesing as type of a supposed new genus *Conocephalus*, but Krabbe (1878) and Drasche (1883) showed that the structure upon which the genus was based was not a part of the worm. Krabbe described it as a new species, *A. conocephalus*; Drasche placed it in the genus *Peritrachelius*; Leidy misdetermined specimens from the Pacific Ocean as "*Ascaris simplex* Rudolphi," and

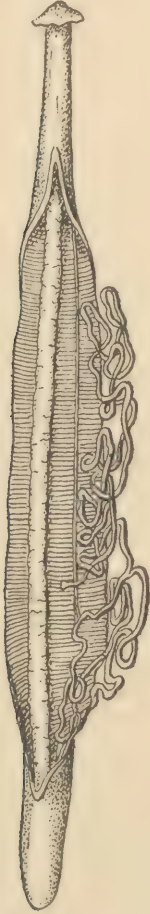


Fig. 30.

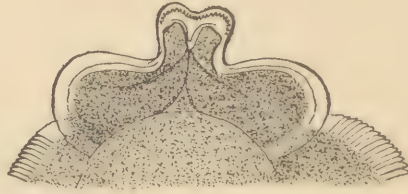


Fig. 31.

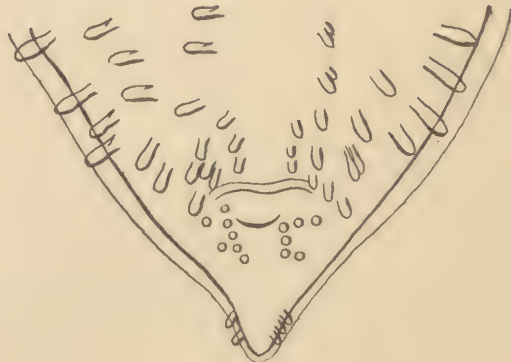


Fig. 32.

it is not at all impossible that Dujardin's "*A. simplex* Rudolphi" = *A. Dussumierii* is identical with this form (see p. 161). In detail the history of the species is as follows:

HISTORICAL REVIEW.—For a discussion of Dujardin's form see page 161. Diesing (1860, p. 669) described a parasite (fig. 30) as *Conocephalus typicus*, type and only species of a supposed new genus, as follows:

Familia XII. Conocephalidea. Character generis unici simul familiae.

XLI. CONOCEPHALUS Diesing.

Corpus elongatum teretiusculum. Caput conicum, limbo suo postico crenulato a corpore distante, retractile. Os in apice capitis. Extremitas caudalis maris semispiralis, subtus excavata, papilla

duplici subterminali, feminae subrecta. Penis apertura genitalis feminea infra corporis medium sita; uterus simplex, ovariis et oviductibus duobus. Ovipara. In Cetaceorum ventriculo endoparasita.

Echinorhynchorum more caput totum in corpus retractile.

I. *Conocephalus typicus* Diesing. Tab. I, fig. 1-11.

Corpus subaequale, transverse striatum. Os minimum. Longit. mar. ad 2'', crassit. ad $\frac{3}{4}$ '', feminae ultra 2'', crassit. 1'', longit. capitis ad $\frac{3}{4}$ ''.

Habitaculum. *Delphinus* (*Delphis?*): in ventriculo, in oceano atlantico sub latit. b. 20° et longit. occ. 39° (*Mus. Hafniense*).

Cl. Steenstrup specimina nonnulla generis hujus insignis Museo Caesareo Vindobouensi dono obtulit.

Krabbe (1878, pp. 49-51, résumé 12) states that the worms Diesing obtained from Steenstrup were collected by Captain Hygom, and that several were retained in the

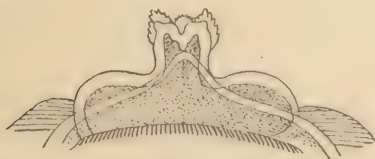


Fig. 33.



Fig. 34.

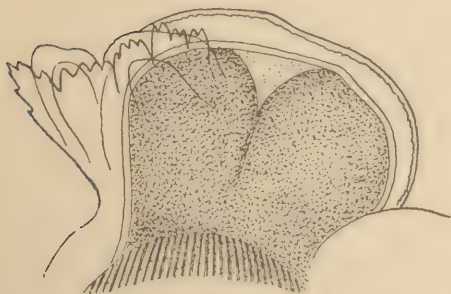


Fig. 35.

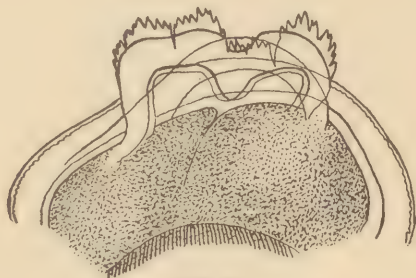
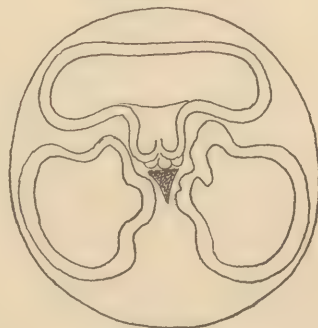


Fig. 36.

Dorsal.



Ventral.

Fig. 37.

Zoological Museum of the University of Copenhagen. Upon examination of this material Krabbe convinced himself that the supposed hood on the head was composed only of coagulated mucus and epithelial cells from the mucosa of the host. When this is separated from the head, three lips are seen and an impression of the lips is noticed on the inside of the hood. Krabbe has noticed similar structures on ascarides of seals, and he explains Diesing's error of interpretation by the fact that when this author published his *Revision der Nematoden* he was blind, and able to work only by the aid of others. Diesing's fig. 8, in fact, which is supposed to represent the head retracted into the body similar to the proboscis of *Echinorhynchus*, in reality exhibits the lips without foreign appendage.

Krabbe proposed the name "*Ascaris conocephalus* n. sp." for this parasite, which was collected by Hygom nine times, by Iverson once, and by Andrea twice, from the stomach of dolphins of the Atlantic between America and Africa, ranging from 4° south latitude to 20° north latitude, and from 23° to 67° west longitude. Reinhardt determined the toothed whales in which Andrea found the worm as belonging to the genus *Olymenia* (= *Prodelphinus*); but regarding the other hosts he was unable to state anything definite.

In one lot of 370 specimens the proportion of males to females was 1:1. The males attained 70^{mm} in length, the females 90^{mm}. The worms are somewhat similar to "*A. simplex*," but differ in essential details of the lips and caudal papillae. The lobes of the lips are provided with a denticulous ridge, are narrower, and more distinctly separated from the rest of the lip (see fig. 31) than is the case in *A. simplex*. Nine or ten pairs of postanal papillae are found on the tail of the male (fig. 32). Of these

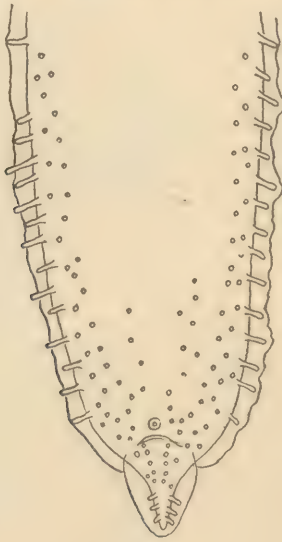


Fig. 38.



Fig. 39.



Fig. 40.

generally three pairs, occasionally two pairs, are conical and near the tip. The other seven pairs are shorter and situated near the cloaca. The numerous praeanal papillae are conical and arranged on each side in three rows, well separated from one another, those situated nearer the cloaca being shorter and more irregularly arranged.

Drasche (1883, pp. 109-111), evidently overlooking Krabbe's paper, reexamined Diesing's original specimens. He found one male with the umbrella-like structure on the head, as described and figured by Diesing, one worm without the head, and two which plainly showed three lips. Upon closer examination he found that the umbrella-like structure on the head was simply a portion of the mucosa of the host. Upon the removal of this mucosa the three lips were plainly visible. These lips (figs. 33-37) Drasche (p. 110) describes as follows:

Die Lippen zerfallen in eine Rücken- und zwei Bauchlippen. Nicht allein jedoch dass die erstere von den letzteren sehr verschieden ist, ja selbst die Bauchlippen sind nicht ganz symmetrisch zu nennen. Die Dorsallippe (Taf. III, Fig. 6 und 7) besitzt eine schräg nach aussen geneigte Basis und zerfällt in zwei halbkreisförmige Seitenlappen und einen zweigetheilten Mittellappen. In letzteren

gehen zwei Lobi ein; an seiner Innenseite bemerkt man eine fein zerschlitzte Zahnplatte, ebenso trägt der Vorderrand der beiden Seitenlappen eine Zahnreihe. Die beiden Bauchlippen haben einen halbkreisförmigen Vorderrand. An ihrer Innenseite sind zwei Zahnplatten zu sehen, welche eine vielfach zerschlitzte Lamelle tragen. Der bogenförmige Vorderrand der Lippe ist mit feinen Zähnen versehen. Wie die 280fache Vergrößerung (Taf. III, Fig. 1 und 2) zeigt, sind diese Bauchlippen keineswegs symmetrisch. Ich muss hier ausdrücklich bemerken, dass die Lippen, ohne durch ein Deckgläschen beschwert zu sein, mit der Camera lucida gezeichnet wurden, dass also die verschiedene Gestalt derselben nicht etwa die Folge einer ungleichen Compression sein kann; übrigens constatirte ich die Asymmetrie der Bauchlippen an zwei Exemplaren. Hinter den Lippen zeigen die Cuticularringe einen schneidenden Rand.

Drasche further mentions the presence of a "Gefässband" similar to what he found in "*Peritrachelius*," in a female 40^{mm} long, it being directly back of the lips and extending caudad for 20^{mm}; its greatest breadth was 1^{mm}, and it extended from the

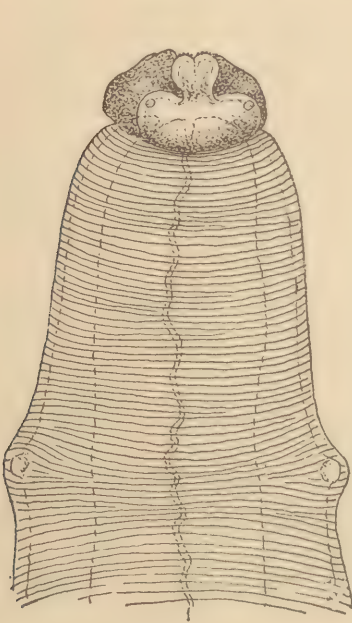


Fig. 41.

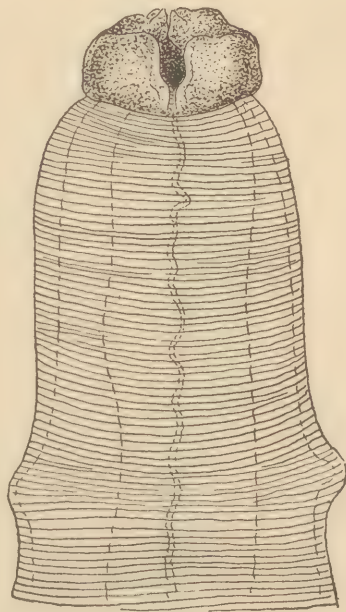


Fig. 42.

right lateral line to the ventral line, surrounding a portion of the intestine. The furrows of the intestine were particularly well developed in the middle portion. The vulva was in about the middle of the animal, 23^{mm} from the anterior extremity in a specimen 40^{mm} long; vagina short; uterus double.

The tail of the male (fig. 38) was curved and was provided with a bursa; ten post-anal papillae were observed, of which Nos. 1, 2, and 3 were conical; over seventy præanal papillae were present, arranged in several longitudinal rows; spicula were not observed.

Drasche concluded that the mouth parts, "Gefässband," bursa, arrangement of the papillae and presence of an evertible penis sheath undoubtedly showed that this worm belonged to Diesing's genus *Peritrachelius*, and he proposed to name it *P. typicus*.

In one of Leidy's (1886, p. 311) articles, we find "*Ascaris simplex*" cited as having occurred in large numbers in "the stomach of a dolphin, *Lagenorhynchus*? Pacific

Ocean." The collection was made by Dr. William H. Jones, U. S. N. Leidy does not describe the specimens, but in his collection we find a bottle (Coll. Leidy, No. 23=U.S.N.M., No. 5015) containing numerous specimens of *Ascaris*, with the label "*Ascaris simplex*. *Delphinus*. Dr. W. H. Jones." As these are the only specimens we find in Leidy's collection bearing a label which in any way corresponds to the data given in Leidy's article, they are probably the worms which Leidy had before him at the time he quoted "*Ascaris simplex*" from the Pacific Ocean. These specimens, as will be shown below, agree in essential characters with the description of Diesing's *Conocephalus typicus* as given by Krabbe and Drasche.

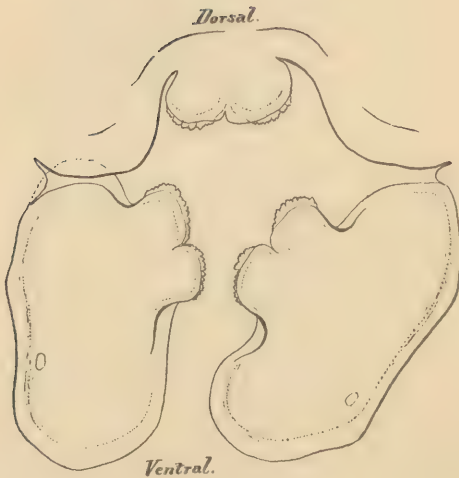


Fig. 43.



Fig. 44.

Von Linstow (1889, p. 25) cites "*Ascaris conocephala*" with "*Conocephalus typicus*" and "*Peritrachelius typicus*" as synonyms.

Jägerskiöld (1894, p. 453) does not state that he has examined this species; his remarks are of historical and nomenclatural nature, and he accepts the name "*Ascaris (Peritrachelius) typicus*."

Stossich (1896, pp. 17, 18) has evidently overlooked Drasche's article on this worm, but gives a diagnosis by which, however, it would scarcely be possible to recognize the parasite. He has evidently not examined specimens, but bases his statements upon Diesing (1860) and Krabbe (1878). He includes Leidy's specimens under *A. simplex*.



Fig. 45.

Since completing this manuscript we have received from the Vienna Museum a bottle containing nematodes labeled "*Ascaris simplex*, *Delphinus phocaena*;" these worms we have redetermined as *Ascaris typica*.

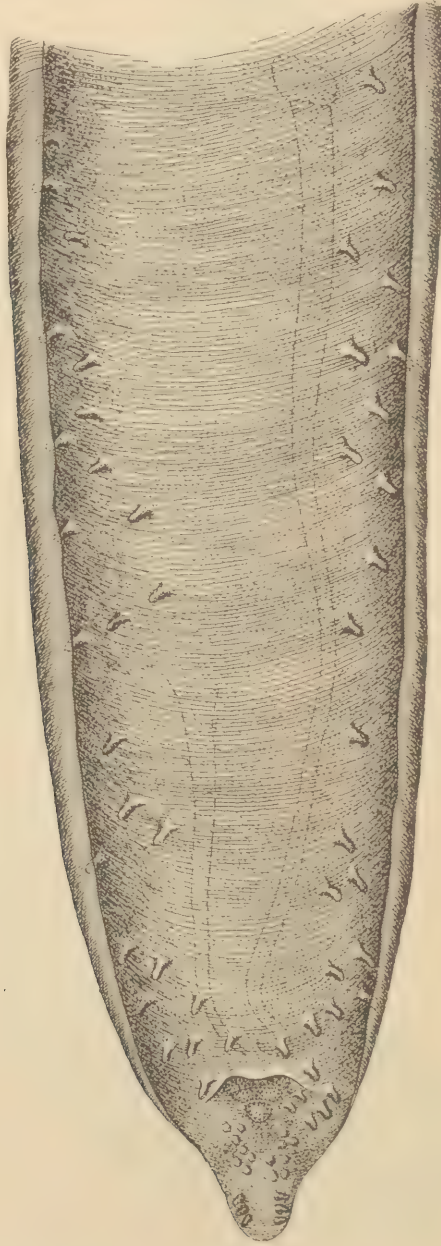


Fig. 46.

SPECIMENS IN LEIDY'S COLLECTION.—The bottle in Leidy's collection (No. 23—U.S.N.M., No. 5015) contains about half a pint of nematodes (figs. 39, 40, 49), rather poorly preserved.

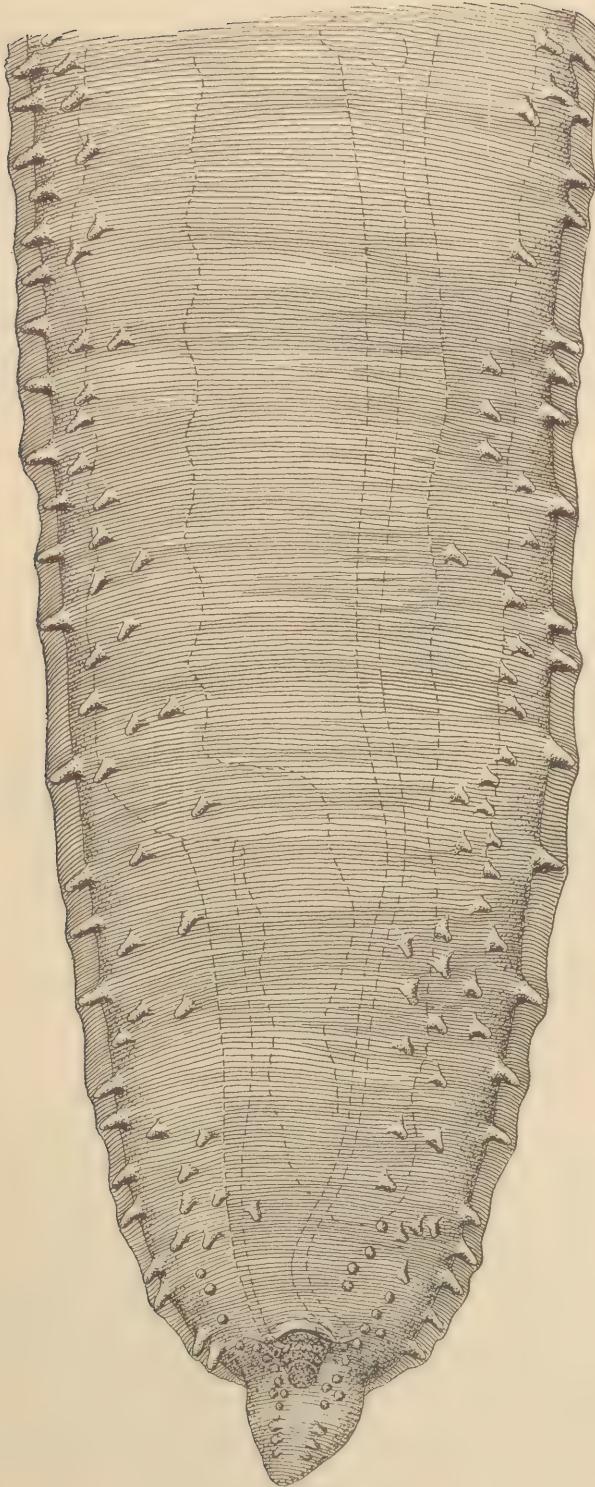


Fig. 47.

These specimens, which we have determined as *A. typica*, represent various stages of development, from young worms 10^{mm} long by 0.27^{mm} broad to fully grown worms 44^{mm} long by 2^{mm} broad.

The head of a female specimen examined measures 0.288^{mm} broad, and 0.112^{mm} long. The base of the dorsal lip measured 0.2^{mm} broad by 88 μ long, while its anterior projection measured only 64 μ broad by 48 μ long (compare figs. 41, 43); the denticerous ridge of the dorsal lip located on the inner surface of this dorsal prolongation, as was figured by Krabbe.

Our observations also agree with those of Krabbe, in that we find the anterior margin (figs. 41, 43) of the median projection indented in the median line, thus forming two lobes, and at this point a prominent tooth is occasionally noticed. The parenchyma forms an anterior lobulate branch into each side of the projection. The basal portion is divided into two lateral rounded lobes, near the antero-lateral margin of which a round papilla is plainly visible. Drasche states that the lateral lobes also

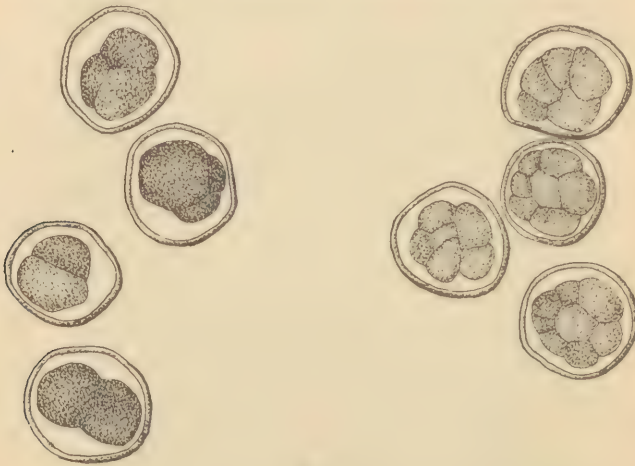


Fig. 48.

bear a denticerous ridge. This we have not been able to verify, although on the margin of the lobes we noticed a structure which might be interpreted as a denticerous ridge, but which appeared to us more like a striation.

The ventro-lateral lips do not, upon first examination, show the distinct division into a prominent anterior narrower and a basal broader portion, such as is described for the dorsal lip; upon careful investigation, however, and especially upon isolation of the cuticle, a bilobed anterior projection may be seen extending into the space between the three lips, similar to but broader than the bilobed anterior portion of the dorsal lip; this projection bears a denticerous ridge; the base of the lip is about 0.16^{mm} broad, and the lip is 0.12^{mm} thick; ordinarily the ventro-lateral lips appear nearly semicircular but asymmetrical in outline. We have not been able to clearly define any denticerous ridge on the base, but we find a number of striae, which might easily be mistaken for such a ridge. The usual papilla is found on the basal portion of each ventro-lateral lip. Intermediate lips are absent; cervical alae absent. The cervical papillae are plainly visible 0.66^{mm} from the anterior extremity. The cuticle of the body is provided with 32 μ transverse cuticular bands, apparently without the finer

striae seen in some other species. The posterior edge of each cuticular band projects prominently beyond the anterior edge of the one next succeeding, so that the edge of the worm appears distinctly serrate. The oesophagus (fig. 44) is divided into two portions; an anterior portion about 4^{mm} long by 0.4^{mm} in diameter at its distal end. This part, which is extremely muscular, is followed by a second portion of different histological appearance and wider lumen, measuring about 1.25^{mm} long by 0.25^{mm} in diameter, and in all cases examined it was sigmoid. The distal end of this body leads directly into the anterior end of the intestine; both oesophageal and intestinal caeca are absent.



Fig. 49.

The adult males (fig. 37) vary from 31 to 38^{mm} long and 1 to 1.5^{mm} in diameter; the proximal extremity is more attenuate than the distal end (figs. 45–47), which is curled, flattened dorso-ventrally, and provided with lateral alae; the postanal portion is conical and bent vertically. Nine to ten, or possibly eleven, pairs of postanal papillae are present; of these, three occasionally two or two and a half pairs of conical papillae are nearer the tip, while six to seven, possibly eight, pairs of shorter papillae are nearer the cloaca. The arrangement of the praeanal papillae varies greatly in different specimens; there may be over seventy-five on each side, arranged in three irregular rows. The cloaca is 0.27^{mm} from the tip of the tail, and extruding from it may frequently be seen the spicules. The latter are of very unequal size, the left spicule (3^{mm}) about three times as long as the right (0.96^{mm} long).

The adult females (fig. 40) vary in length from 37 to 44^{mm}, in breadth from 1.5 to 2^{mm}, and are attenuated slightly toward each extremity. The vulva, according to Diesing, lies distal of the middle of the body; according to Drasche, about in the middle. In one of our specimens, 44^{mm} long, the vulva was found 20^{mm} from the head. The vagina measured 6^{mm} long, the body of the uterus 8^{mm}, the horns 8^{mm}. The eggs (fig. 48) are globular, 40 μ to 56 μ , and undergo segmentation in the uterus. The anus is about 0.26^{mm} from the tip of the conical tail.

Nomenclature.—The specific term *typica* has priority, while Diesing's (1850) name *Peritrachelius* can not be applied to this form, either as generic or subgeneric name, even should, as Drasche thinks, *A. typica* be generically (or subgenerically) related to *Peritrachelius insignis*, since *A. typica* belongs in Dujardin's (1845) subgenus *Anisakis*, of which we make it the type.

Young specimens of Ascaris typica.—Besides the adults described above, U.S.N.M. No. 5015 contains numerous specimens (figs. 49–52) of young ascarides corresponding



Fig. 50.



Fig. 51.

to the young forms of *A. decipiens* described on page 116. They measure 15 to 22^{mm} in length by 0.25 to 0.34^{mm} in breadth, and present the characters usually given for "*A. capsularia*." The ventral tooth is slightly more prominent than in the young of *A. decipiens*. Specimens may be found with the larval cuticle, or with this cuticle partially discarded.

We do not hesitate to look upon these as the young of *A. typica* and to assume that the host becomes infected by eating fish.

4. ASCARIS BICOLOR Baird, 1868 [nec Rudolphi, 1793]. Sp. inq.

(Figs. 53–57.)

? 1809, *Ascaris simplex*, Rudolphi, see pages 120–126.

1868, *Ascaris bicolor* BAIRD [nec RUDOLPHI, 1793], Proc. Zool. Soc. London, p. 71, figs. A–C. — MURIE, 1868, Proc. Zool. Soc. London, pages 67–71. — VON LINSTOW, 1878, Compendium der Helminthologie, p. 42. — STROSSICH, 1896, Boll. Soc. adriatica Sci. nat. Trieste, XVII, p. 67.

DIAGNOSIS.—Intermediate lips absent; lateral cervical alae absent; lips distinct, prominent, rounded, of moderate size, more distinct and larger than in *A. simplex*, and provided with a denticulous ridge. Body cylindrical, attenuated anteriorly (but less so than *A. simplex*), of a brownish color, except at the anterior extremity which is white; the posterior extremity is sometimes red. Cuticle

provided with cuticular bands 0.024 broad, but without finer striae; the bands give a serrate appearance to the margin of the worm, when seen under the microscope. Oesophagus consists of two portions, an anterior and a posterior; oesophageal and intestinal caeca absent.

Length (all females?): 62 to 75^{mm}; breadth 2 to 2.5^{mm}.

Cotypes: British Museum and Coll. B. A. I. (U.S.N.M., No. 2824).

Habitat: Stomach of marine mammals.

Host.	Locality.	Collector.	Authority.
<i>Odobenus rosmarus</i>	Died at London	Murie, 1867	Murie and Baird, 1868, pp. 67-71.

SUMMARY.—This supposed species from *Trichechus rosmarus* (= *Odobenus rosmarus*) should not be confused with "*A. bicolor* Rudolphi, 1793," from *Perca fluviatilis*. *A. bicolor* Baird was described in 1868 from specimens taken from a walrus; it has not been reported since that time. We have examined several of Baird's originals, but having no males we are unable to definitely place the worm, although we are somewhat inclined to look upon it as identical with *A. simplex*. Murie, who collected the nematodes, considered them to be the cause of death of a walrus he examined. The worm is cited by von Linstow (1878) and Stossich (1896), but these authors did not examine specimens. In detail the history of the parasite is as follows:

HISTORICAL REVIEW.—As the original article by Murie and Baird has an important medical as well as zoological bearing, we quote it here in full, with the original illustrations:

(1868.)

[p. 67.]

4. On the Morbid Appearances observed in the Walrus lately living in the Society's Gardens. By James Murie, M. D., Prosector to the Zoological Society. With a Description of a New Species of *Ascaris* found in the Stomach. By Dr. Baird, F. L. S.

In 1853 the society obtained a very young walrus (*Trichechus rosmarus*, Linn.), which specimen unfortunately only lived some few days after its arrival. From that time up to the 1st of November last (1867) no opportunity has offered of adding another example of this exceedingly interesting animal to the collection. When, therefore, a tolerably well-developed, although still young, male sea horse was reported to have arrived safely in the gardens, the curiosity of the members of the society and the public generally naturally was aroused. Notwithstanding the inclemency of the weather the number of visitors was great.

The proper food of a walrus in a state of nature has been variously stated by different naturalists. Some assert it to be a vegetable eater; others believe it to be entirely carnivorous, while a third notion has gained ground that it may occasionally partake of food of the one kind or the other.

Our superintendent, therefore, under these circumstances, felt a difficulty in deciding what might be the best food to give the creature so as to retain it in as good health as possible. The results of his experiments concerning suitable diet he has himself laid before the society's meetings on a previous occasion. I shall just reiterate his conclusions, namely: It refused every kind of seaweed offered, but it greedily gulped up the soft bodies of *Mya truncata* and *M. arenaria*, which were its principal food, besides quantities of whelks, mussels, fish cut up in small strips, and the viscera of fish; these last, however, having previously been well washed and cleaned.

It may be remarked that the young walrus dissected by Professor Owen in 1853 had been fed during its captivity on oatmeal, milk, and water. The specimen at present under consideration, when first captured, and on shipboard, had also received a certain allowance of the above, along with strips of fat pork.

I have taken notice of the animal's food for the purpose of directing attention to the question, whence were the ova of the entozoa obtained that ultimately led to the walrus's death?

At the period of arrival in the gardens the walrus looked thin and lean. There was an amount of loose skin, however, which indicated that better regimen than that which he had lately been under would soon render the body plump and comparatively free from the very numerous skin folds. These wrinkles, it may be observed, in several places met each other, so as to form a series of elongated diamond-shaped inclosures.

It was early noticed that the conjunctivæ were suffused and injected with blood. This gave the eyes a disagreeable appearance [p. 68]. The animal at times chattered or rattled his teeth together in a very remarkable and noisy manner. This last habit, however, was put down to temper, or as a sign of hunger; the sanguineous effusion to a cold received during transport.

After the lapse of a few weeks it would seem that the body and limbs acquired more vigor; for the gait became altered; so that in walking on all fours, sea-bear fashion, the abdomen and chest were raised from the ground, whereas at first the animal rather trailed or dragged along than walked. This showed that the animal was growing stronger in body, an equivalent in some measure to improvement in health. It was noticed all the while that it remained emaciated and did not increase in stoutness or otherwise become fatter, although the quantity of food it consumed was enormous. The ravenousness of its appetite was something extraordinary, and many thought that the animal was underfed.

The walrus thus was considered by every one who saw it to have had apparently uninterrupted health till Monday the 16th of December. On that day the keeper first began seriously to apprehend that the animal was out of order—as he thought—constipated, but meanwhile it did not refuse food.

On Mr. Bartlett being consulted, he proposed to give it some oily substance which might act as a purgative. One pound and a half of horse fat, cut in strips, was therefore given the afternoon following. The next morning there were copious alvine evacuations. What passed at first was hard, black, and fetid, but the excretions became moister, though still very dark colored.

When this occurred it was thought relief was obtained and that the animal would go on well. It did not seem, however, to rally, but died rather suddenly on Thursday the 19th.

The body was examined by me a day afterwards and disclosed unusual conditions.

Not a particle of subcutaneous fat was present, and the mesentery and other abdominal parts usually containing fatty substances were equally destitute of such.

The viscera of the thorax and abdomen, with the exception of the interior of the stomach, appeared quite sound. The brain was also normal in structure.¹

[69.] On opening the stomach, which was of moderate size, I was much surprised to find that it contained small, round worms, a species of *Ascaris*, in such quantities that, when these were turned out, there was altogether about half a pailful. They occupied the entire interior of the viscus, but were in greatest abundance at the bend of the peculiar siphon-like stomach.

The entozoa swarmed between the rugæ, and in many cases were firmly attached to the membrane. The mucous membrane lining the interior was of an intense red hue; but here and there were somewhat paler patches. More rigid examination showed that these last were extensive ulcerations, the mucous membrane being entirely eroded, and only the muscular and a very thin lining of submucous tissue remained, preventing perforation of the walls of the stomach. The chief ulcerations were some four in number, and varied in size and situation.

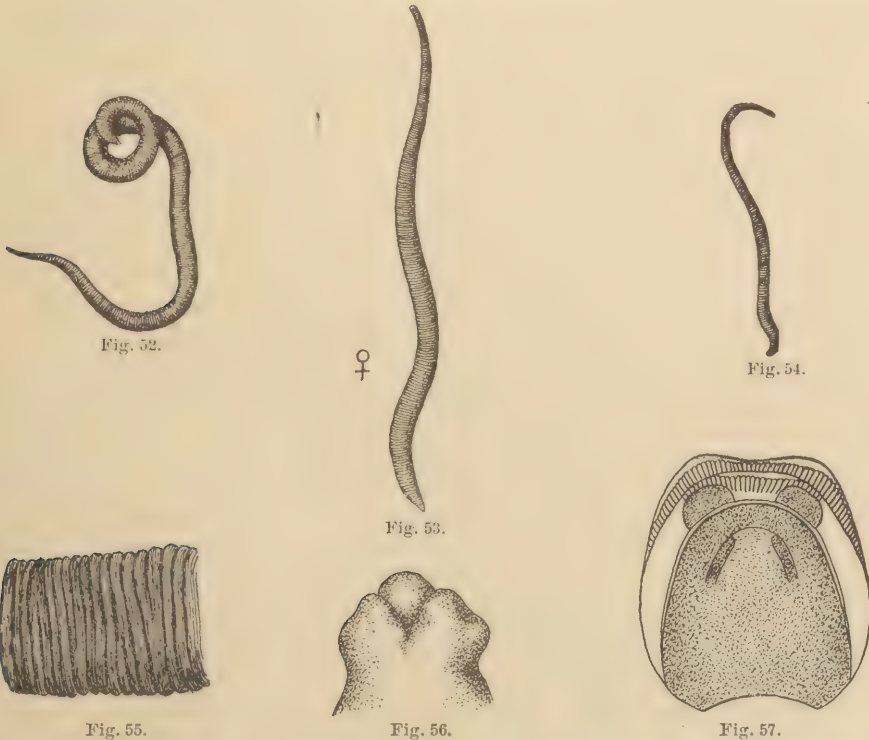
One, nearly circular, three-fourths of an inch in diameter, occupied the anterior wall at a distance of between 5 and 6 inches from the cardiac end. Another, somewhat diamond-shaped, 2½ inches by 1½ at widest, also existed on the anterior wall of the viscus and about its middle. In the ulcerated erosion, the mucous coat was in some parts so excavated underneath as to leave one-half inch of an overhanging lappet of membrane. On a section being made vertically, the submucous tissue was seen to be absent, the muscular and serous coats alone preventing perforation of the wall. At this part of the wall the stomach had a thickness of only 0.1 of an inch, although it seemed as if the muscular fibers were slightly increased in numbers here, possibly from the effects of the irritation

¹When the brain was taken out, its general appearance and firmness of texture, as implied above, was that of health. As it was desired for anatomical investigation, it was not then cut into or interfered with further than cursory examination permitted. At one point it was noticed that unusual vascularity existed; but as the diseased condition of the stomach was thought sufficient of itself to account for death, no great attention was then paid to this superficial cerebellar congestion. Subsequent examinations showed, however, that upon the upper surface of the cerebellum (between the posterior cerebral lobes) and underneath the injected pia mater an abscess had begun to be formed. The brain surface immediately underneath was very slightly softened, but around it was quite firm. The morbid deposit and infiltration had chiefly implicated the pia mater over the superior vermiciform process. Whether this lesion was the more immediate cause of death, and not the ulcerated condition of the stomach, is an open question. Some of the symptoms during life might, indeed, be referred to it.

going on in the neighborhood and within. A third ulcer, of an elliptical form, $2\frac{1}{2}$ inches long, and with more regular edges than the preceding, had been eaten away on the anterior wall, close to the lesser curvature of the stomach and between 5 and 6 inches from the pylorus. Between the second and third erosions here described, but on the posterior wall of the stomach, another very extensive patch of ulceration had taken place. This ulcer stretched between the greater and lesser curvatures. It had a semilunar figure, was rather more than 4 inches long, possessed irregular borders, and varied from one-half to 1 inch in width. The mucous coat around had been undermined in a manner similar to that described above as occurring in the second ulcer. To the right and lying parallel with this large excavation were a series of small circular and ovoid spots, which had been eroded in like manner with those already described. The spots just spoken of varied in size from about a three-penny piece to a shilling, and they evidently were fast running into one single, long ulcer, resembling that upon the left side. Only a very few worms were found here and there in the intestinal tract; some were observed to have passed previously to the horse fat having been given.

Dr. Baird, of the British Museum, having examined some of the entozoa, considers them new to science, and sufficiently different to require a new specific name. He proposed therefore, that of *Ascaris bicolor*, on account of a peculiarity common to most of [p. 70] them, viz, that the posterior half of the body is more or less of a reddish or pinkish hue, the remaining segment being pale colored. I myself incline to the opinion that this coloration may not be of a specific kind, but due in some measure to the intensely congested condition of the stomach and sanguineous nature of the food. The accompanying figures I have had drawn under my supervision; and Dr. Baird is pleased to consider them a faithful delineation.

ASCARIS BICOLOR, Baird.



A. [Figs. 52-54.] Three female specimens, of about the natural size; that to the left shows the manner in which occasionally the caudal end is found coiled up.

B. [Fig. 55.] Portion near the middle of the body, enlarged so as to display the transverse striations and how some of them interdigitate.

C. [Fig. 56.] Magnified view of the head and labia.

There still remain two points worthy of consideration—viz: the cause of death, and whence the entozoa were derived.

1. Death seems to have resulted from the ulceration of the stomach. It is not clear, though, why the animal should have succumbed so suddenly. Literally speaking, these ulcerations were so extensive that it is curious the animal should have survived so long. The chronic stage of the ulceration alone accounted for this. This instance is one exemplifying pure, chronic gastritis, due, no doubt, to the presence in such numbers of the entozoa.

2. It has been said by some parties that the entozoa were possibly derived from food given to the walrus after its arrival at the gardens; but there are many reasons against this being a likely circumstance. In the first place, the fact of the entozoa being a new species peculiar to the walrus militates against the above assertion [p. 71]. Again, the ulceration apparently took a longer period to attain the chronic stage extent than the few weeks' residence of the walrus in the gardens would account for. Furthermore, the nature of the food given at the gardens and the care and regularity with which it was examined make it unlikely that such swarms of entozoa were derived from it and developed in so short a period. Whether the entozoa had been derived from the food given on board ship or in what manner they had originally reached the stomach of the walrus are questions which I am quite unprepared to answer, and speculation leaves the matter quite as undecided.

Dr. Baird has furnished the subjoined description of this *Ascaris*, which proves to belong to a new species.

ASCARIS BICOLOR, Baird.

Head naked; labia distinct, prominent, rounded, and of moderate size. Both anterior and posterior portions destitute of alae or wings. Body of worm cylindrical, attenuated anteriorly, of a brownish color, except at anterior extremity, which is white; the posterior extremity is sometimes red. The surface of the body is beautifully and minutely but distinctly striated across; as seen under the microscope (with a power of two-thirds of an inch), the striae on each side terminate in such a manner that the edges of the body appear as if serrated. Caudal extremity thicker than anterior, obtuse, and generally convoluted.

A great many specimens were found in the stomach; but apparently all were females.

The *Ascaris simplex* of Rudolphi, found in the stomach of the porpoise (*Phocaena communis*), very nearly approaches this species in general appearance and size, but differs from it in several respects.

The *Ascaris bicolor* is less attenuated at the anterior extremity than the *A. simplex*, and is destitute of alae or wings equally at the posterior and at the anterior extremity. The striations on the surface of the body are much finer, and the labia or valves at the mouth are more distinct and larger.

Length from $2\frac{1}{2}$ to 3 inches; breadth from 2 to $2\frac{1}{2}$ millimeters.

Habitat: Stomach of a young male walrus (*Mus. Brit.*).

REEXAMINATION OF COTYPES.—Almost at the moment of going to press we have received through the kindness of Prof. J. Jeffrey Bell, of the British Museum, several of Baird's originals of this worm. All of the specimens are females, and on this account we are unable to definitely place the parasites. They are poorly preserved, but we were able to distinguish a denticerous ridge on the lips; no intermediate lips were present; the cuticular bands measure $24\ \mu$ broad, and are *apparently* not provided with any finer striation; the oesophagus resembles the oesophagus described by Jägerskiöld for *A. simplex*, oesophageal and intestinal caeca being absent. Further than this we are not willing to make any statements upon the material at hand.

We refrain from proposing a new name for the homonym *A. bicolor* Baird, as we doubt the validity of the species.

b. Denticerous ridge double.

5. ASCARIS PATAGONICA Linstow, 1880.

(Fig. 57.)

1880, *Ascaris patagonica* VON LINSTOW Arch. Naturg., XLVI, 1, pp. 41-42, pl. III, fig. 1.—VON LINSTOW 1889, Compendium. Nachtrag, p. 18. — STOSSICH, 1896, Boll. Soc. Adriatica Sci. nat. Trieste, XVII, pp. 20-21.

DIAGNOSIS.—Intermediate lips absent; cervical alae absent; lips with a double dentigerous ridge; in all three lips, the pulpa of the inner surface is divided into two roundish lobes; outer surface of dorsal lip elongate, oval, with narrow base; body thick and solid; cuticle with rather broad transverse cuticular bands together with very much finer transverse striae; tail clavate.

Male: 28^{mm} long by 1.3^{mm} broad; tail with obtuse conical projection; caudal papillae very numerous and crowded.

Female: 57^{mm} long by 2^{mm} broad; eggs 60 μ in diameter, with hyaline membrane widely separated from vitellus.

Type: Kiel University Museum, No. 40.

Habitat: Stomach of marine mammals.

Host.	Locality.	Collector.	Authority.
<i>Otaria jubata</i>	Patagonia.....	(?)	Von Linstow, 1880, p. 41.

Von Linstow (1880, p. 41-42) described this species with the following diagnosis:

1. ASCARIS PATAGONICA n. sp. (K. Nr. 40).

Fig. 1 [see fig. 57].



Fig. 58.

Aus dem Magen von *Phoca jubata*. Patagonien.

Die Gestalt ist dick und gedrungen. Lippen ohne Zwischenlippen mit doppelten Zahnleisten; bei allen dreien ist die Pulpa an der Innenseite in zwei rundliche Ausläufer gespalten. Die Aussen- seite der Oberlippe ist längsoval mit schmaler Basis. Die Haut zeigt Querstreifen in ziemlich breiten Abständen, zwischen denen wieder viel feinere Querstriche eng gedrängt stehen. Das Schwanzende ist kolbig, beim Männchen in eine stumpfe, conische Spitze ausgezogen.

Die Länge des Männchens beträgt 28, die Breite 1 $\frac{1}{2}$ ^{mm}; die Papillen am Schwanzende stehen sehr dicht und sind zehr zahlreich.

[p. 42]. Das Weibchen hat eine Länge von 57 und eine Breite von 2 mm.

Die Eier sind kugelförmig; sie haben eine hyaline, von dem Dotter weit abstehende Hülle und einen Durchmesser von 0.06^{mm}.

Die bekannten Formen, welcher hier in Frage kommen könnten, sind *Ascaris osculata*, *decipiens* und *similis* welche von dieser Form durchaus verschieden sind, wie aus Krabbe's neuester (1878) Darstellung der in Robben und Walen gefundenen *Ascaris*-Arten ersichtlich ist.

No other original observations have been made upon this parasite.

B. The ventro-lateral lips, said to bear a papilla armed with 6 to 7 small teeth [—dentigerous ridge on a bilobed projection?].

6. *ASCARIS KÜKENTHALII* Cobb, 1888. Sp. inq.

(Figs. 58-64.)

? 1809, *Ascaris simplex* RUDOLPHI, see page 121.

1888, *Ascaris Kükenenthalii* COBB, Jenaische Zeitschr. f. Naturw., XXIII (n. F. XVI), 1, Dec. 8, 1888, pp. 44-59, pls. III, figs. 1-11, IV, 12-30.—COBB, 1889, Archiv f. Naturg., 55 Jhg., I, pp. 149-150, pl. VII, figs. 4-6.—STOSSICH, 1896, Boll. Soc. adriatica Sci. nat., XVII, p. 53.

1894, *Ascaris Kükenenthalii* COBB, as probable synonym of *A. simplex* Rud., JÄGERSKIÖLD, Zool. Jahrb., VII, pp. 474-476.

DIAGNOSIS.—Intermediate lips absent; lateral cervical alae absent; head (male) scarcely 0.33^{mm} broad, lips of nearly equal size; lobes not mentioned; dentigerous ridge not mentioned, but one papilla on each ventro-lateral lip said to bear teeth; dorsal lip bears a symmetrical pair of papillae, the ventro-lateral lips said to possess 3 papillae each; an upper one [double lobed projection?] with 6 to 7 teeth, a lower one on which no teeth were visible, and a very small one about in the middle of the inner side; cervical papillae 1^{mm} from the head. Excretory organ discharges between the ventro-lateral lips. Body attenuated toward both extremities. Transverse cuticular bands 30 μ . Oesophagus composed of two portions; anterior portion 5^{mm} long by 1^{mm} in diameter (distal end); posterior portion 2 to 2.5^{mm} long, generally sigmoid; caeca apparently absent.

Male: 70 to 90^{mm} long by 2 to 3^{mm} thick; tail with lateral alae; 7 to 8 pairs of postanal papillae; 1 to 4 near the tip; 5 to 8 near the cloaca, of which 6 and 7 are double; about 90 pairs of praeanal papillae extending about 10^{mm} forward from tip of tail; of these 6 to 10 pairs of short papillae lie antero-lateral of the cloaca; then follows cephalad on each side a row of longer papillae; apparently two median papillae immediately in front of the cloaca; left spiculum (2.3^{mm}) slightly larger than the right (1.7^{mm}).

Female: 80 to 100^{mm} long with maximum breadth of 2.5^{mm}; vulva a little anterior to middle of the body. Eggs reach the morula stage in the uterus.

Habitat: Stomach of marine animals.

Host.	Locality.	Collector.	Authority.
<i>Delphinapterus leucas</i>	Advent Bay, West Spitzbergen.	Kükenthal	Cobb, 1888, p. 44; 1889, p. 149.
? <i>Phoca barbata</i> .....	.....	.....	Stossich, 1896, p. 53.

HISTORICAL REVIEW.—This species was described by Cobb, but Jägerskiöld thinks it probably identical with *A. simplex*. In detail the history of the species is as follows:

Ascaris Kükenenthalii, collected by Kükenthal, August, 1886, from the stomach of *Beluga leucas* (= *Delphinapterus leucas*) in the Advent Bay (West Spitzbergen), was described as a new species by Cobb (1888, pp. 44-59). While his anatomical discussion is excellent, he omits some extremely important points of systematic value; apparently he was not acquainted with Krabbe's work upon the parasites from this host.

He describes the male (fig. 58) as 70 to 90^{mm} long, by 2 to 3^{mm} broad: head scarcely 0.33^{mm} broad; body attenuate anteriorly, and very slightly pointed posteriorly; tail is curved and provided with a bursa; the papillae are figured (fig. 61)

and agree to a great extent with the papillae figured by Krabbe for *A. simplex*; there are four pairs near the tip of the tail, three other pairs closely posterior to cloaca, an irregular row of simple papillae on each side antero-lateral to cloaca, and a row of longer papillae anterior to these; one larger and one small papilla appear to be present in the median line immediately anterior to the cloaca; in all about 100 papillae are present on each side, extending about 10^{mm} forward from tip of tail. The cuticular bands measure 30μ . The left spicule (2.3^{mm}) is slightly larger than the right (1.7^{mm}). The dorsal lip (fig. 62) bears in the middle a symmetrical pair of papillae (evidently a double-lobed projection); the ventro-lateral lips apparently possess three papillae each; an upper one with 6 to 7 small teeth (possibly another double-lobed projection), a lower one on which no teeth were visible, and about in the middle of the inner side a third of very small dimensions.

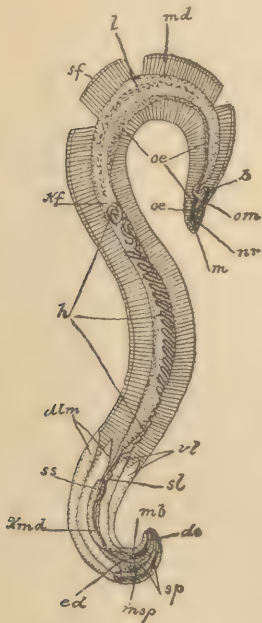


Fig. 59.

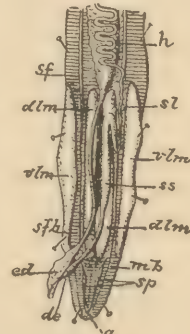


Fig. 60.



Fig. 61.

The female (fig. 63) is described as 80 to 100^{mm} long, with a maximum breadth of 2.5^{mm} ; the vulva is five-elevenths of the length of the body from the anterior extremity (a little anterior to the middle of the body); the vagina measures 10^{mm} long, the bicorn uterus 20^{mm} , the receptacula seminis 10^{mm} ; the ovaries 210 to 216^{mm} , the entire female genital organs thus being about three times as long as the worm. Eggs reach the morula stage in the uterus.

The oesophagus (fig. 64) is divided into two portions; an anterior part 5^{mm} long by nearly 1^{mm} in diameter (at posterior end), and a posterior portion 2 to 2.5^{mm} long, generally sigmoid. The intestine has three rows of V-shaped cellular bodies, such as Jägerskiöld (1894) described for *A. simplex*. Intestinal caeca are apparently not present. The sub-intestinal glands (back of the oesophagus) measure 0.6^{mm} broad by 30 to 40^{mm} long. The sub-oesophageal excretory organs are 2^{mm} broad and extend beyond the middle of the body. The cervical papillae are situated 1^{mm} from the head.

Cobb's second (1889, pp. 149, 150) article is for the most part a reprint of page 44 of his first article.

Jägerskiöld (1894, pp. 474-476) calls attention to the resemblance of *A. Kükenthalii* to *A. simplex*; he inclines decidedly to the view that the two forms are identical, but in the absence of specimens of *A. Kükenthalii* for comparison he reserves judgment. Stossich (1896, p. 53) cites *A. Kükenthalii* as a distinct species, gives a condensed diagnosis taken from Cobb's description, and adds *Phoca barbata* as a host. This new host, for which Stossich does not give his authority, is probably an error, and might have occurred while referring to Cobb's second article.

From the above review it will be clear that *A. Kükenthalii* bears a close resemblance to *A. simplex*; we agree with Jägerskiöld that the two forms are probably identical; in fact, we think there can be scarcely any doubt regarding this point. Cobb's median symmetrical papillæ of the dorsal lip would correspond to the small anterior bilobed projection of *A. simplex*, as his figure (see fig. 62) shows; the armed papilla of each ventral lip would correspond to dentigerous ridge of the ventral lips of

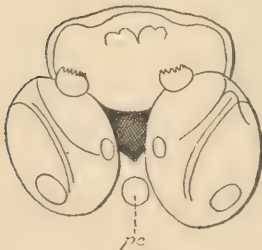


Fig. 62.

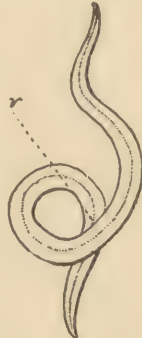


Fig. 63.

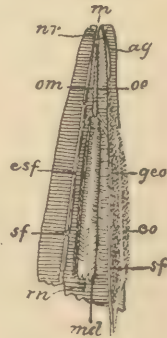


Fig. 64.

A. simplex; the other essential characters are practically the same in both forms. Not having specimens of either *A. simplex* or *A. Kükenthalii*, however, we follow Jägerskiöld in retaining the species as distinct, hoping that the originals of *A. Kükenthalii* may be found and reexamined.

C. Data concerning the dentigerous ridge wanting.

7. *ASCARIS SIMILIS*, Baird, 1853. Sp. inq.

(Figs. 65-69.)

1853, *Ascaris similis*, BAIRD, Catalogue Entozoa Brit. Mus., p. 19, pl. i, figs. 1a-d.—BAIRD, 1853, Proc. Zool. Soc. London, Part XXI, p. 18.—BAIRD, 1855, Ann. and Mag. Nat. Hist., 2 ser., XV, pp. 69, 70.—DIESING, 1860, Sitzungsber. Akad. Wiss. Wien, XLII, no. 28, p. 656.—VON LINSTOW, 1878, Compendium der Helminthologie, p. 44.—STOSSICH, 1896, Boll. Soc. adriatica Sci. nat. Trieste, XVII, p. 63.

DIAGNOSIS.—Intermediate lips absent; lips of about equal size, slightly projecting beyond the margin; dentigerous ridge (?); body attenuated more toward anterior than toward posterior extremity, which is thick, round, and obtuse; wing extending along the whole length and becoming thicker and stronger at inferior extremity; cuticle with fine transverse striae.

Male (female?): About 50^{mm} long by 2^{mm} broad; straight to within a short distance of tail, which is inflected; of a whitish color.

Female (male?): About 37^{mm} long by 1.5^{mm} broad; spirally twisted in many convolutions; of a dark-olive color.

Types: In British Museum.

Habitat: Stomach of marine mammals.

Host.	Locality.	Collector.	Authority.
Antarctic seal, gen. ? sp. ?	Antarctic.....	(?)	Baird, 1853, p. 19.

HISTORICAL REVIEW.—This form was described by Baird in 1853, and has not been found or examined since that time. Professor Bell writes to us that the types are in very poor condition. Baird's (1853, p. 19) original diagnosis reads as follows—

ASCARIS SIMILIS, Baird.



Fig. 65.



Fig. 66.



Fig. 67.



Fig. 68.



Fig. 69.

Length of male 2 inches, breadth 1 line. Length of female 1½ inches, breadth three-fourths of a line. Anterior portion much narrower than posterior. Head small, mouth with three small valves slightly projecting beyond the margin. Tail rounded, thick, obtuse. Females spirally twisted in many convolutions, of a dark-olive color. Male straight to within a short distance of tail, which is inflected; of a whitish color. Skin minutely and finely striated across. Wing extending along the whole length and becoming thicker and stronger at inferior extremity. Differs from preceding species (*A. osculata*) in having the wing stronger and thicker at inferior extremity, in having the head and mouth smaller, and having the skin finely striated across.

Habitat: Stomach of a seal from Antarctic regions.

Collected during the late Antarctic expedition. Presented by the Admiralty.

Baird's figures show that the intermediate lips are absent; his figure 1a, of a supposed male, is probably a female, while 1c. of a supposed female, is probably a male. In his second paper Baird (1853, p. 18) repeats his original diagnosis, with some slight verbal changes. The diagnosis in his third paper (1855, pp. 69, 70) is a reprint of the diagnosis given in the second paper.

Neither Diesing (1860, p. 656), von Linstow (1878, p. 44), nor Stossich (1896, p. 63) add any original observations.

8. ASCARIS HALICORIS Owen in Baird, 1859.

(Figs. 70-75.)

(1833), *Ascaris halichoris* OWEN, Catalogue of the Physiological Series of Comparative Anatomy, Museum of the College of Surgeons, p. 121, London. Nomen nudum. (Quoted from Baird, 1859.)

(1834), — ? — RÜPPELL, Abhandl. Senkenberg. Museum, I, p. 106.

1838, "*Ascarides*" in Dugong OWEN, Proc. Zool. Soc. London, Part VI, p. 30.

1839, "*Ascaris* of a Dugong," OWEN, Art. Entozoa, Todd's Cyclopaedia of Anatomy and Physiology, II, p. 136.

1851, *Ascaris dugonis* DIESING, Systema Helminthum, II, p. 191. Nomen nudum. Refers to Rüppell, 1834.

1859, *Ascaris halicoris* BAIRD, Proc. Zool. Soc. London, Part XXVII, pp. 148, 149, pl. LVI, figs. 2-2c.—Reprinted without figures, BAIRD, 1860, Ann. Nat. Hist., 3 ser., V, No. 28, April, pp. 329-331.—DIESING, 1860, Sitzungsber. k. Akad. Wiss. Wien., XLII (1860), No. 28, p. 662.—VON LINSTOW, 1878, Compendium der Helminthologie, p. 59.—C. PARONA, 1889, Ann. Mus. civico, Storia nat. Genova, 2 ser., VII (XXVII), 10 Oct., pp. 751-761, figs. 1-3, pl. XIII, figs. 1-16.—GROSSICH, 1896, Boll. Soc. adriatica Sci. nat. Trieste, XVII, p. 68.

DIAGNOSIS.—Intermediate lips and lateral cervical alae absent; lips of nearly equal size, dorsal lip slightly broader than ventro-lateral lips; dentigerous ridge?; body attenuated toward both extremities; cuticle with fine transverse striae; intestinal caecum 11^{mm} long, arises about 17^{mm} from mouth, and extends cephalad parallel to oesophagus.

Male: 85 to 115^{mm} long; tail in a spiral; caudal papillae symmetrical, one pair postanal, near the cloaca, four pairs praeanal; spicules very short.

Female: 85 to 144^{mm} long, with maximum diameter of 3.5^{mm}; vulva about two-thirds the length from the anterior extremity (Baird), one-third the length from the anterior extremity (Parona); eggs segment to morula in the uterus.

Types: In British Museum.

Habitat: Stomach of Dugongs.

Host.	Locality.	Collector.	Authority.
<i>Dugong dugon</i>	Penang	Owen.....	Owen, 1838, p. 30.
<i>Dugong dugon</i>	Red Sea.....	Rüppell.....	Baird, 1859, pp. 148, 149.
<i>Dugong dugon</i>	Assab.....	Ragazzi.....	Parona, 1889.

HISTORICAL REVIEW.—According to Baird (1859, p. 148), Professor Owen in 1831 prepared a specimen of an *Ascaris* from the stomach of a Dugong, and deposited the same in the museum of the College of Surgeons, London; Baird also refers to the Catalogue of the Physiological Series of Comparative Anatomy, which was published by the college in 1833, in a way which leads the reader to assume that Owen named the species *Ascaris halicoris*. This catalogue is not at our disposal, but as Baird adds (1859, p. 149) that "*Ascaris halicoris*, though named long ago, has never been fully described or figured," it may safely be assumed that Owen's name was a *nomen nudum*, and hence not entitled to further consideration.

Rüppell, according to Baird, "found the same species of worm in the stomach of the same species of animal. He very briefly notices this in describing a Dugong which he found in the Red Sea," but merely mentions that the entozoa "were found in a clustered glandular apparatus in the stomach and were 5 inches long." His description of the Dugong was sent in a letter to Dr. Sömmering, and is dated from the island of Dabalac, on the Abyssinian coast of the Red Sea, in the month of January, 1832. This paper was published in the first volume of the Museum Senckenbergianum, in 1834."

Owen (1838, p. 30), in discussing the stomach of the Dugong, refers to his specimens with the sentence: "And in each case the gland was infested by *Ascarides*, hereafter to be described, which left impressions upon the spiral membrane."

Owen (1839, p. 136) again refers to this parasite, in discussing the accessory glands of the digestive system of entozoa, as follows:

The second example of an accessory digestive gland occurs in a species of *Ascaris* infesting the stomach of the Dugong. Here a single elongated caecum is developed from the intestine at a distance of half an inch from the mouth, and is continued upward, lying by the side of the beginning of the intestine, with its blind extremity close to the mouth; from the position where the secretion of this caecum enters the intestine, it may be regarded as representing a rudimentary liver. (See the Preparation, No. 429A, Mus. Coll. Surgeons, Phys. Catalogue, p. 121.)

Brandt (1846, p. 192) simply mentions the worms found by Rüppell and Oyen in connection with the ascarides of Steller's sea cow.

Later Brandt (1849, p. 100) briefly refers to these parasites as follows:

In ventriculo ceterum nec non glandulae cavo et duodeno invenit (Stellerus) lumbricos candidos (Ascarides) numerosos $\frac{1}{2}$ longos. Simile quid observarunt Ruppelius (Museum Senkenb., I, p. 106) et Owenius (Zoolog. proceed., P. VI, p. 30) in Halicore.

It is evidently this passage upon which the citation by some authors of the occurrence of *A. halicoris* in *Rhytina stelleri* (= *Hydrodamalis gigas*) has been based. It is clear, however, that from the data at hand there is no justification for assuming that the parasites from the two hosts are identical.

Diesing (1851, p. 191) next cites this parasite as "*Ascaris Dugonis* Brandt" among his *species inquirendae*, referring to the articles by Rüppell and Brandt (1846 and 1849). The name was not used by Brandt; it is to all purposes a *nomen nudum*, as the description reads only "Longit. corp. 5."

From a nomenclatural standpoint the parasite was not described until 1859, when Baird (1859, pp. 148, 149, pl. LVI) figured it, and gave the following description:

ASCARIS HALICHORIS Owen.

Caput nudum, epidermide stricto adnata; os labiis rotundatis, porrectis; corpus, in utroque sexu, extremitatibus magis attenuatis; extremitate caudali brevi, subulata. nuda.

Long. feminae, $3\frac{1}{4}$ unc.; maris, $2\frac{1}{4}$ unc.

The body is of a whitish color, thickest in the center, gradually tapering to each extremity. The body is strongly striated across; in the female, apparently all its length; in the male, till nearly about half an inch from its posterior extremity. This latter portion is smooth or slightly striated lengthways. In the female the vagina is situated at about two-thirds of its length from the anterior extremity. The spicula of the male appear very short. The intestine, as described by Professor Owen, has a caecum developed from it at the distance of about half an inch from the mouth, and is continued upward, lying by its side, and terminating in a blind extremity near the mouth. The specimens, now in the British Museum, are shorter than those noticed by Rüppell.

(The figures will explain this structure.)

In the collection of the British Museum.

Baird's (1860, pp. 329-331) second article is practically a reprint of his first discussion (1859).

Diesing's (1860, p. 662) diagnosis is based upon Baird's (1859) description; Stossich (1896, p. 68) gives a citation of this worm by Diesing (1861, Sitzungsber. k. Akad. Wiss. Wien, XLVII, p. 277), but we have been unable to verify the reference.

Von Linstow (1878, p. 59) gives both *Halicore cetacea* and *Rhytina stelleri* as harboring *A. halicoris*, but does not cite his authority for the latter host.

Parona (1889) appears to be the next to discuss *Ascaris halicoris*. He studied specimens of ascarides collected by Vincezo Ragazzi in two Dugongs ("*Halicore cetacea*") in Assab. After an historical review of the parasite he describes the anatomy of Ragazzi's specimens, the description differing in some particulars from the diagnosis given by Baird. According to Parona the females measured 85 to 144^{mm} in length; with a maximum diameter of 3.5^{mm}; the males measured 85 to 115^{mm} in length. The head is apparently without intermediate lips, and no mention is made of labial dentition. A caecum is present running parallel to the oesophagus, as described by Owen; in a female 135^{mm} long this caecum opens into the intestinal tract 17^{mm} from the mouth and measured 11^{mm} in length. The vulva was about on

the border between the first and second thirds of the body, 42^{mm} from the anterior extremity in a specimen 124^{mm} long, 45^{mm} in one 135^{mm} long, and 40^{mm} in one 110^{mm} long. Baird states that of his specimens "the vagina is situated at about two-thirds of its length from the anterior extremity." The position of the vulva is the great point of difference between the descriptions of the worms studied by Baird and



Fig. 70.



Fig. 71.

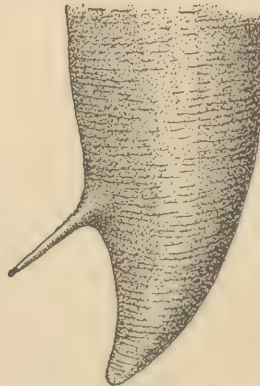


Fig. 72.



Fig. 73.

Parona. Whether Baird accidentally measured from the tail instead of the head, we do not care to state; such an error would be possible, but hardly probable. That such a variation in the position of the vulva would occur, seems improbable. The vaginal canal measured 6.5^{mm} in length, the double uteri 29^{mm}.

Baird described the cuticle of the female as transversely striated the entire length of the body, while the striae of the male extended only to within half an inch of the

end of the tail; Parona, on the other hand, found the striation of the male present on the tail as well as on the other portions of the body.

Unfortunately Parona's figures of the tail of the male are rather unsatisfactory. He states that the tail is spirally wound; that the spicules are short, not protruding more than 2^{mm} , and that five symmetrical pairs of papillae are present. Judging from his figure, four pairs of these papillae are praeanal and one pair postanal.

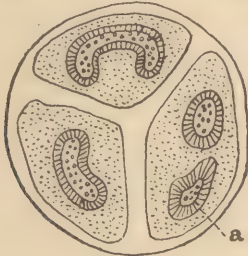


Fig. 74.



Fig. 75.

Stossich (1896, p. 68) places *Ascaris halicoris* among the doubtful species; his diagnosis is evidently based upon Parona's work, and he cites both *Halicore indica* and *Rhytina stelleri* as hosts.

II. Intermediate lips present.

9. ASCARIS OSCULATA Rudolphi, 1802, det. Schneider, 1866.

(Figs. 76-92.)

? 1802, *Ascaris osculata* RUDOLPHI, Arch. f. Zool. und Zootomie, II, II, pp. 14, 15.—RUDOLPHI, 1809, Entozoorum hist. nat., II, I, pp. 135-136.—RUDOLPHI, 1819, Entozoorum synopsis, pp. 39, 651-652.—BELLINGHAM, 1844, Ann. and Mag. Nat. Hist., XIII, p. 169.—DUJARDIN, 1845, Hist. nat. des Helminthes, p. 164.—DIESING, 1851, Systema helminthum, II, p. 169.—BAIRD, 1853, Cat. Entoz. Brit. Mus., p. 18.—BASTAIN, 1866, Phil. Trans. R. Soc. London, CLVI, pp. 545-638, pl. xxvi, figs. 6-12.

? 1803, *Fusaria osculata* (RUDOLPHI, 1802), ZEDER, Anleitung z. Naturg. Eingeweidew., p. 105.

1866, *Ascaris osculata* RUDOLPHI, 1802, of SCHNEIDER, Monographie d. Nematoden, p. 44, with fig., pl. I, fig. 13.—KRABBE, 1878, Oversigt K. Danske Videnskab. Selskabs Forhand., p. 45, pl. I, fig. 1.—COBBOLD, 1879, Parasites, pp. 313, 314, figs. 59a-b.—VON LINSTOW, 1880, Arch. f. Naturg., 46 Jhg., I, pp. 44, 45.—VON MARENZELLER (1882-83), Internat. Polarforsch. Wien., p. 18.—NEHRING, 1884, Sitzungsber. Gesellsch. naturf. Freunde Berlin, no. 4, p. 59.—BRAUN (1891), Arch. d. Fr. Naturg. i. M., p. 110.—JÄGERSKIÖLD (1893), Akadem. Afhandl. Stockholm, pp. 10-16, pls. II, fig. 12, IV, 35, V, 39.—VON LINSTOW, 1892, Jahr. Hamb. wiss. Anstalten, IX, 2, pp. 8, 9, pl. II, figs. 11-16.—JÄGERSKIÖLD, 1894, Zool. Jahrb. VII, pp. 457-463, pls. xxv, fig. 12, xxvii, 35, 36, xxviii, 38.—VON LINSTOW, 1895, Archiv. f. mikr. Anat., XLIV, pp. 528-531, pl. xxxi, figs. 1-14.—STOSSICH, 1896, Boll. Soc. ardiatica Sci. nat. Trieste, XVII, p. 37-38.

DIAGNOSIS.—Intermediate lips present; lateral cervical alae absent; lips large, of about equal size, with an inner lateral dentate projection, but without denticulous ridge. Immediately back of the head for about 0.13^{mm} , the anterior border of the each cuticular ring covers the posterior border of the ring immediately in front; beyond this peculiarly formed differentiation the posterior margin of each cuticular ring covers the anterior margin of the next ring. Cuticular bands 8μ broad without finer striation. Oesophagus composed of two portions; distal portion generally with caecal appendage; oesophageal and intestinal caeca present.

Male: 34 to 70^{mm} long by 1.5^{mm} in diameter; tail hooked or curled ventrally, with narrow or broader alae; 8 to 11 pairs of postanal papillae; of these 1 to 4 are near the tip; one pair of double papillae and several (3 or more) pairs of single papillae nearer the cloaca; 30 or more pairs of praeanal papillae arranged on each side somewhat irregularly or in two rows; spicules equal 3.7^{mm} (von Linstow), 6 to 8^{mm} (Stiles and Hassall) long.

Female: 40 to 80^{mm} long by 1.5 to 2^{mm} in diameter; vulva on a prominent transverse ridge about one-third the distance from the anterior end. Eggs spherical, 67 to 83 μ segmenting to the morula stage in the uterus.

Habitat: Stomach of marine mammals.

Host.	Locality.	Collector.	Authority.
<i>Cystophora cristata</i>	Greenland	Olrik	Krabbe, 1878, p. 45.
<i>Erignathus barbatus</i>	Iceland	Thienemann	Diesing, 1851, p. 169.
<i>Erignathus barbatus</i>	Baffins Bay	Dr. Leach	Baird, 1853, p. 18.
<i>Erignathus barbatus</i>	Greenland	Olrik	Krabbe, 1878, p. 45.
<i>Erignathus barbatus</i>	Specimens from Vienna Museum.	.....	Stiles and Hassall, 1899, p. 157.
<i>Eumetopias stelleri</i>	Bering Sea	Lucas, 1896	Stiles and Hassall, 1899, p. 158.
<i>Halichoerus grypus</i> .....	.....	Creplin	Diesing, 1851, p. 169; Krabbe, 1878, p. 45.
<i>Halichoerus grypus</i>	Specimens from Kiel Museum.	.....	Linstow, 1880, p. 44.
<i>Halichoerus grypus</i>	Rügen	Nehring	Nehring, 1884, p. 59.
<i>Monachus albiventer</i>	Specimens in Vienna Museum.	.....	Diesing, 1851, p. 169.
<i>Monachus albiventer</i>	Specimens from Vienna Museum.	.....	Stiles and Hassall, 1899, p. 157.
<i>Odobenus rosmarus</i>	Greenland	Olrik	Krabbe, 1878, p. 45.
<i>Otaria jubata</i>	Patagonia	(?)	Parona, catalogue MS.
<i>Phoca foetida</i>	Specimens in Greifswald Museum.	.....	Diesing, 1851, p. 169.
<i>Phoca groenlandica</i> .....	.....	Bremsø	Rudolphi, 1819, p. 651.
<i>Phoca groenlandica</i>	Greenland	Gieseke	Diesing, 1851, p. 169.
<i>Phoca groenlandica</i>	Iceland	Thienemann	Diesing, 1851, p. 169.
<i>Phoca groenlandica</i> .....	.....	Schneider, 1866, p. 44.	Schneider, 1866, p. 44.
<i>Phoca groenlandica</i>	Greenland	Vahl, Mørch, Olrik, Pfaff.	Krabbe, 1878, p. 45.
<i>Phoca groenlandica</i>	Specimens from Vienna Museum.	.....	Stiles and Hassall, 1899, p. 158.
<i>Phoca pantherina</i>	Greenland	Gieseke	Diesing, 1851, p. 169.
<i>Phoca pantherina</i>	Specimens from Vienna Museum.	.....	Stiles and Hassall, 1899, p. 157.
<i>Phoca vitulina</i>	Greifswald	Rudolphi	Rudolphi, 1809, p. 135; 1819, p. 59.
<i>Phoca vitulina</i>	(?)	Wewetzer	Rudolphi, 1809, p. 135.
<i>Phoca vitulina</i> .....	.....	Bakker	Rudolphi, 1819, p. 651.
<i>Phoca vitulina</i>	Specimens of collection of Siebold, British Museum.	.....	Bellingham, 1844, p. 169; Baird, 1853, p. 18.
<i>Phoca vitulina</i>	Öresund	Kinckowstrom	Jägerskiöld, 1894, p. 457.
<i>Phoca vitulina</i>	Specimens from Vienna Museum.	.....	Stiles and Hassall, 1899, p. 157.
<i>Stenorhynchus leptonyx</i>	Antarctic, South Georgia Land.	Hamburg Museum ...	Linstow, 1893, p. 89.
Seal, gen. ?, sp. ?	Farøe	Müller	Krabbe, 1878, p. 45.
Seal, gen. ?, sp. ?	Iceland	Steincke	Do.
Seal, gen. ?, sp. ?	Greenland	Jørgensen	Do.

SUMMARY.—This worm, found in the stomach of the sea lion of Bering Sea, is identical with the form described by Rudolphi in 1802, as defined by Schneider in 1866. It is also found in Iceland, Greenland, and elsewhere. In detail its history is as follows:

HISTORICAL REVIEW.—Rudolphi (1802, pp. 14, 15) was evidently the first to describe *Ascaris osculata*; his article is not at our disposal at present. The following year Zeder (1803, p. 105) placed Rudolphi's species in the genus *Fusaria*, giving the following short diagnosis, taken from Rudolphi:

Osculata Fusar. capitis corpore angustioris valvulis orbicularibus marginatis, cauda brevissima acuta.

Habitat in ventriculo phocae vitulinae.

Rudolphi (1809, p. 135, 136) next describes the worm as follows:

7. ASCARIS OSCULATA. R.

Ascaris: Capitis valvulis orbicularibus marginatis: corpore aequali, linea laterali non exstante, cauda acuta.

Hab.: Inter ventriculi *Phocae vitulinae* plicas specimina complura Novembri offendi.

Descr. Vermes quinque ad decem lineas longi, tenues, albi aut flavescentes.

Caput corpore parum angustius, valvulis tribus orbicularibus magnis, distincte marginatis, et sub vermibus motu formam mutantibus, ut cum Taeniarum oculis suctoriis (unde nomen triviale desumsi)

quodammodo convenient. Corpus utrinque subattenuatum, antrosus fere tenuius. Cauda brevissima acuta. Genitalia feminae ut in reliquis; maris duplo minoris spicula exserta non vidi. Tubus cibarius pro more.

Obs. 1. Vermes phocae ante biduum occisae vividissimi, vasculo aquae repleto et furno (mane et modice tantum calefacto) imposito commissi, nycthemeron, 36 horas et ultra vixere.

Obs. 2. Cl. Hellwig specimen a cl. quondam Wewetzer, Med. Cand. in *Phoca vitulina*, nescio quo loco, repertum mecum communicavit, meis duplo majus, crassiusculum, cujus pars postica anteriore omnino crassior est, ceterum vero, quantum in verme mortuo conspiciere licet, huc pertinere videtur, ut *Ascaris nostra* forsitan ad sectionem quintam amandanda sit.

Later (1819, pp. 39, and 651-652) he mentions that it was at Greifswald that he found his specimens; that Bakker found specimens which were larger than his, and

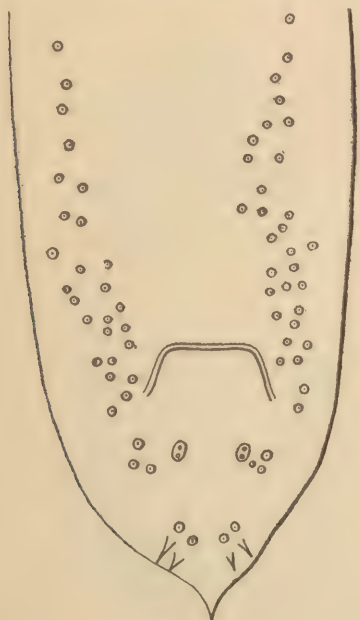


Fig. 76.



Fig. 77.

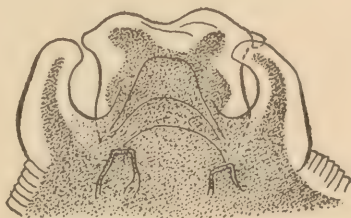


Fig. 78.

that Bremser found specimens in *Phoca groenlandica*, of which the male was 15, the female 18 to 24 lines long. In describing the worms, Rudolphi adds:

Caput valvulis majusculis marginatis, suborbicularibus, a quibus nomen desumsi, instructum. Corpus posteriora versus minus attenuatum; cauda crassa, maris inflexa, apice brevissimo acuto, ante quem spicula duo longissima, incurva; cauda feminae recta obtusa cum brevissimo et tenui apice acuto. Membrana lateralis in apice colli latior obtusiuscula, tum tenuis decurrens, brevi tenuissima et fere invisibilis.

Specimina mea pusilla comparavi, et horum quoque reperi, quibus pars posterior crassior est, reliqua convenient.

Bellingham (1844, p. 169) mentions the presence of *A. osculata* in the oesophagus and posterior nares of *Phoca vitulina*, but makes no further observations on the species.

Dujardin (1845, p. 164) takes his description from Rudolphi (1809 and 1819) and does not appear to have seen this form. Diesing (1851, p. 169) adds nothing in the way of anatomical characters, but gives several additional hosts, namely, *Phoca pantherina* [= ?], *P. gryphus* (= *Halichoerus grypus*), *P. hispida* (= *P. foetida*), *P. barbata* (= *Erignathus barbatus*), and *P. monachus* (= *Monachus albiventer*).

Baird (1853, p. 18) cites *A. osculata* in the collection of the British Museum, the specimens coming from the stomach of *Phoca ritulina* (collection of Siebold) and of *P. barbata* (= *Erignathus barbatus*), collected by Leach at Baffins Bay.

Schneider (1866, p. 44) appears to be the first to clearly define this worm and to figure it (see figs. 76 and 77); his diagnosis reads:

C. Lippen ohne Zahnleiste mit Aurikeln und Zwischenlippen.

14. ASCARIS OSCULATA. R.

♀ 50mm. ♂ 40mm.

Eckzahn klein und stumpf, hinterer Rand der Aurikeln beginnt mit einem convexen Bogen. Rinne tief. An der Basis der Lippen und Zwischenlippen unter der Haut läuft rings herum ein car-

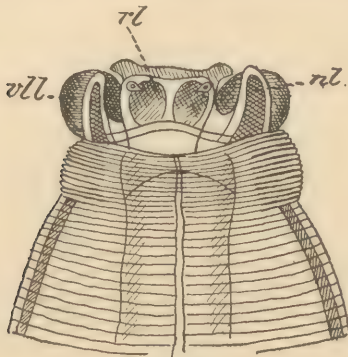


Fig. 79.

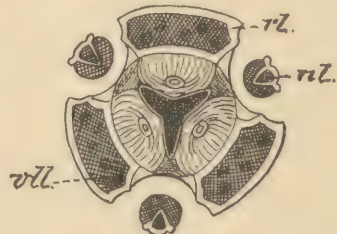


Fig. 80.



Fig. 81.

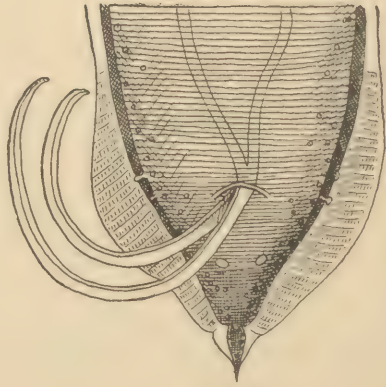


Fig. 82.

minrother Pigmentstreif. Schwanz des ♂ 8 Papillen hinter dem After, 1 und 2 mit kegelförmiger Pulpa, 7 und 8 bilden eine Doppelpapille, dann folgen vor dem After 20 und mehr Papillen unregelmässig zu 2, 3, und 4, und zuletzt eine Reihe Papillen. Im Ganzen 70 gezählt.

Phoca groenlandica. Darm.

Bastain (1866) in his extensive discussion of the anatomy of nematodes refers a number of times to a worm determined as *A. osculata*. One of his figures of the anterior extremity shows three lips, but no intermediate lips; he states that the intestinal caecum is present, but the oesophageal caecum absent. It is not at all improbable that Bastain had some other form, possibly *A. decipiens*, as suggested by von Linstow, rather than *A. osculata*.

Krabbe (1878, p. 45) mentions the worm from various hosts. It was found ten times in *Phoca groenlandica*, in Greenland, by Vahl, Mørch, Olrik, and Pfaff; in

Iceland, by Hallas; twice in *Phoca barbata* (= *Erignathus barbatus*), by Olrik, in Greenland; three times in *Halichoerus grypus*, locality not given; once in *Cystophora cristata*, by Olrik, in Greenland; twice in *Trichecus rosmarus* (= *Odobenus rosmarus*), by Olrik, in Greenland, and five times in undetermined seals, on Faroe, by Müller; Iceland, by Steinche, and Greenland, by Jörgensen and Müller. As many as 200 to 300 were occasionally found in a single seal, the proportion of males to females being about 2:3.

While Schneider gives the measurements of the male as 40^{mm}, of the female 50^{mm}, Krabbe found the males attaining 60^{mm}, the females 80^{mm} in length. He was unable to observe the carmine pigment ring mentioned by Schneider.

Cobbold (1879, pp. 313, 314), states that *Ascaris osculata* seems to be present in full-grown seals of every kind. In 1862-1864 he conducted a series of experiments with the eggs of this worm, rearing embryos both in salt and fresh water, but the feeding of the young worms to various animals led to no result. He watched the



Fig. 83.



Fig. 84.



Fig. 85.

growth of the embryos until they had acquired well-marked digestive organs and a length of one twenty-fifth of an inch, their size when emerging from the egg shell in the water having been about one one-hundred-and-fiftieth of an inch only. His figure of the female shows a characteristic prominent transverse ridge at the position of the vulva, about on the border of the first and second anterior thirds of the body.

Von Linstow (1880, pp. 44, 45) records the same species from the stomach of *Halichoerus grypus* (Zool. Mus. Univ., of Kiel, No. 9). His observations on the dorsal lip differ somewhat from Krabbe's, as he found the margin provided with teeth; the rounded lateral projections belong to an inner layer and lie in the same plane with the outer surface.

Von Marenzeller's (1882-83, p. 18) article is not at our disposal.

Nehring (1884, p. 59) states that he found numerous specimens in a *Halichoerus* shot at Goehren (Rügen) in 1882; he also found an *Ascaris* in 1884, in *Halichoerus grypus*; the parasites were not determined definitely, but Karsch stated to him that they were closely related to *A. osculata*.

Von Linstow (1892, p. 89) records *Ascaris osculata* from stomach of *Stenorhynchus leptonyx*, in Süd-Georgien, Antarctic (Hamburg Museum, No. 15326). The cuticula is regularly striated at distances of 7 to 8 μ ; the cervical papillae are situated 0.85^{mm} from the anterior end; the lips are large and without any dentigerous ridge; the dorsal lip measures externally 0.091^{mm} long by 0.12^{mm} broad, and on its inner anterior surface it is prolonged laterally on each side in an angular projection. Immediately back of the lips the cuticle possesses deep folds. In both sexes the tail is conically pointed. The oesophagus is 1 8.4 as long as the body. Oesophageal and intestinal caeca are present. The males attained 40^{mm} in length by 1.5^{mm} in diameter; spicules equal and

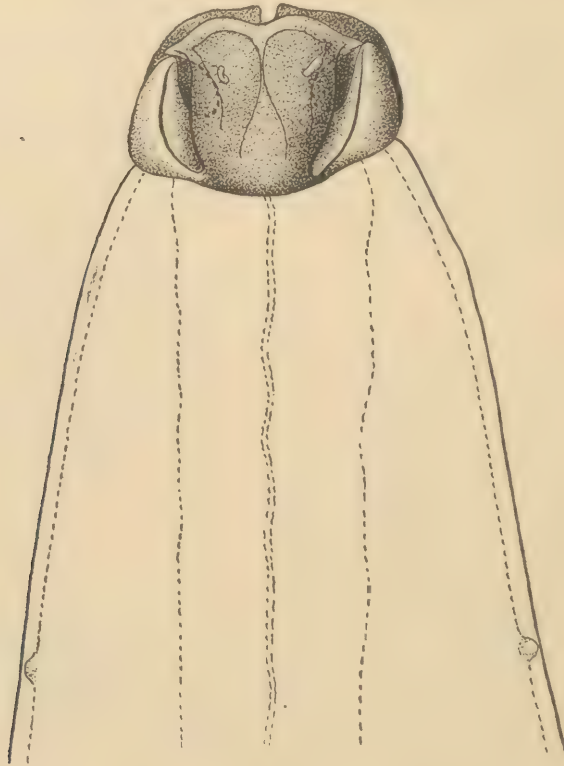


Fig. 86.

very long (3.7^{mm}); tail 1 91 as long as body; caudal bursa present; about 45 pairs of caudal papillae are present, of which about 15 pairs are figured as postanal, one pair of large double papillae being present about halfway between the cloca and tip of the tail. The females attain 54^{mm} in length by 1.58^{mm} in diameter; the vagina is situated about one-third the length from the head; eggs measure 83 by 67 μ .

Jägerskiöld's (1893) article is not at our disposal at present. In his second paper (1894, pp. 457-463) Jägerskiöld discusses specimens collected by Klinekowström from the nasal cavity of *Phoca vitulina* at Öresund. He finds the vulva situated one-third the length of the body from the head, and describes the oesophageal and intestinal caeca as present (fig. 83); his other statements are chiefly regarding the microscopic

anatomy and histology of the intestinal tract and glands; the excretory pore is found closely back of the ventral intermediate lip.

Von Linstow (1895, pp. 528-531) contributes an histological discussion of some portions of the worm; he believes that Bastain's (1866) specimens were probably *A. decipiens* rather than *A. osculata*.

Stossich (1896, pp. 37, 38) gives a short diagnosis of the worm, including *Ascaris bulbosa* Cobb (see p. 111) as synonym.

In Leidy's collection we find a bottle (No. 259=U.S.N.M., No. 5051) containing nematodes with the label "*Ascaris osculata*, *Macrorhinus angustirostris*, Dr. Chapman," which we cited in a former publication (Stiles & Hassall, 1894, p. 340.) We have as

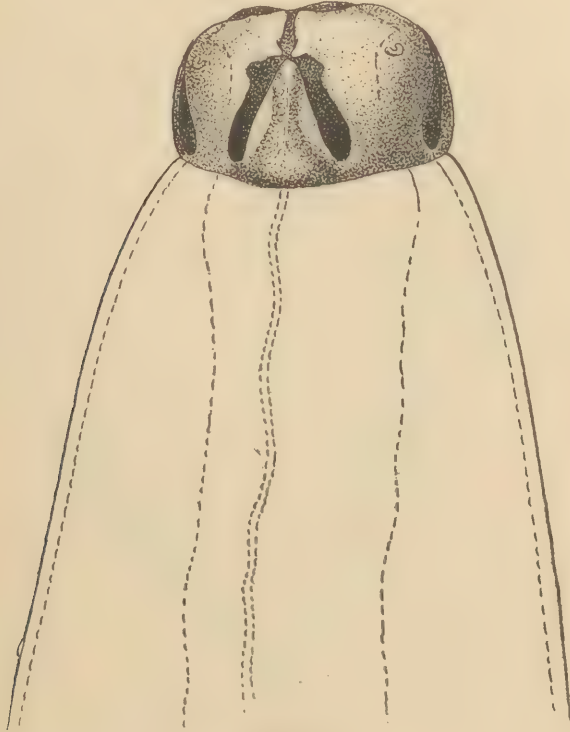


Fig. 87.

yet been unable to find where Leidy published this determination, or whether he published it at all. A reexamination of the parasite has resulted in changing the determination to *Ascaris decipiens* (see p. 112).

Since finishing this report we have received several bottles of parasites from the Vienna Museum, which we have examined with the following results: One bottle labeled "*Ascaris osculata*, *Phoca barbata*" contained both *A. osculata* (B. A. I., No. 2831) and *A. decipiens* (B. A. I., No. 2841). One bottle with label "*Ascaris osculata*, *Phoca ritulina*" we have redetermined as *A. decipiens* (B. A. I., No. 2832). A bottle (B. A. I., No. 2833) labeled "*Ascaris osculata*, *Leptonyx monachus*" is correctly determined. A bottle (B. A. I., No. 2834) labeled "*Ascaris osculata*, *Phoca pantherina*"

contains very poorly preserved specimens, but the determination is evidently correct. A bottle labeled "*Ascaris osculata*, *Phoca groenlandica*" contains both *A. osculata* (B. A. I., No. 2835) and *A. decipiens* (B. A. I., No. 2843).

SPECIMENS FROM EUMETOPIAS STELLERI.—In the material brought to Washington by the seal commission are three bottles of worms taken from the stomachs of three specimens of *Eumetopias Stelleri*. The worms were collected by Mr. Lucas in August, 1896, on St. George Island, Bering Sea, and two of the lots represent very



Fig. 88.

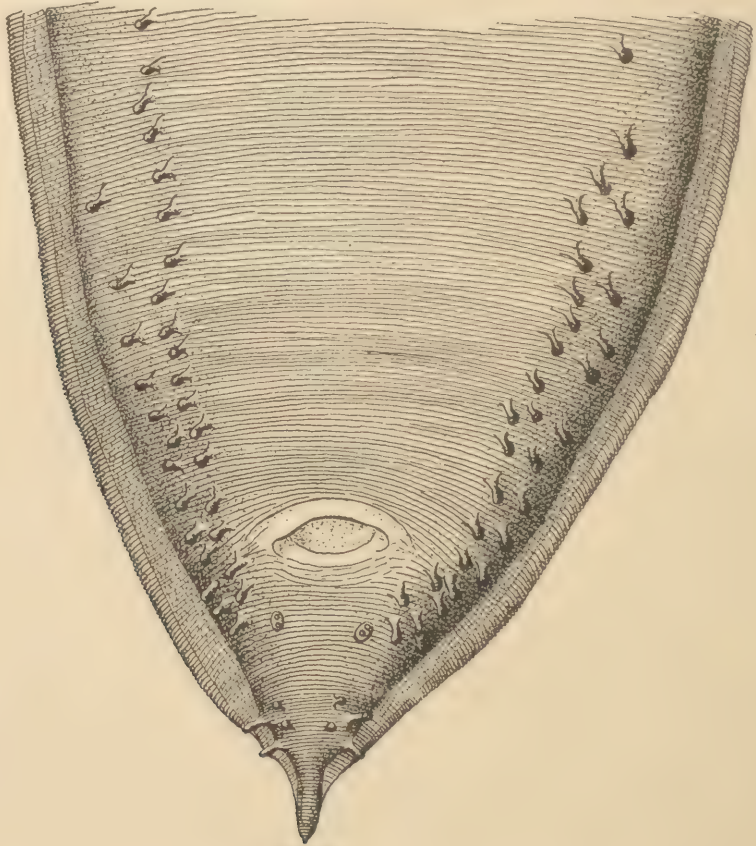


Fig. 89.

heavy infections. One lot (tag of seal commission 82) contained both *Ascaris decipiens* (U.S.N.M., No. 2822) and *A. osculata* (U.S.N.M., No. 2767), while the other two lots (tag of seal commission 84=U.S.N.M., No. 2764, and tag 85=U.S.N.M., No. 2766) apparently contained only *Ascaris osculata*.

Our determination of these worms (figs. 84, 85) as *Ascaris osculata* is based upon the following details:

Intermediate lips present (figs. 86, 87); lips with lateral projections; oesophageal and intestinal caeca present; cuticular bands without finer striae; cuticular folds back of lips (fig. 88).

Male: 9 to 10 pairs of postanal papillae (fig. 89), of which 1 to 4 are near the tip; 1 pair of double papillae and 3 to 4 pairs of single papillae nearer the cloaca; spicules very long, 6 to 8^{mm}.

Female: Prominent vulvular ridge about on border between first and second anterior thirds of body.

As the species is quite well studied from a systematic standpoint, we will not give a detailed discussion of the worm found in Bering Sea, but will confine ourselves to the following statements:

Von Linstow mentions deep cuticular folds immediately back of the lips. These folds, which are very prominent in our specimens, are due to the arrangement of the cuticular bands (fig. 88). For a distance of about 0.13^{mm} back of the lips the anterior border of each band extends for some distance over the posterior border of the band immediately in front of it, while on the rest of the body the posterior border of each band extends only very slightly over the anterior border of the band immediately distal to it. The portion of the body to which the lips are attached is thus differentiated into a peculiar and quite characteristic manner. On the body the cuticular bands are about 8 μ broad, but the finer intermediate striation is lacking. The cervical papillae are found about 0.9^{mm} from the head.

We find considerable variation in the arrangement of the caudal papillae in the males, but the arrangement of four pairs of papillae near the tip of the tail and a pair of double papillae between these and the cloaca appear quite constant.

The prominent transverse vulvular ridge figured by Cobbold is quite characteristic. We also find that the eggs (68 to 72 μ) segment to the morula stage in the uterus.

10. ASCARIS LOBULATA Schneider, 1866.

(Figs. 90-92.)

? 1819, *Ascaris delphini* RUDOLPHI, see page 162.

1866, *Ascaris lobulata* SCHNEIDER, Monographie der Nematoden, p. 44, one fig. ♂ tail.—KRABBE, 1878, Oversigt K. Danske Videnskab. Selskabs Forhand, 1, p. 47, pl. 1, fig. 2.—JÄGERSKIÖLD, 1894, Zool. Jahrbüch, VII, p. 467, pl. xxviii, fig. 37.—STROSSICH, 1896, Boll. Soc. adriatica Sci. Nat. Trieste, XVII, p. 43.

DIAGNOSIS.—Intermediate lips present; lateral cervical alae ?; lips similar to those of *A. osculata*, but stronger; the anterior lobes of the pulpa extend into the lateral projections; cuticular striation? Oesophagus composed of two portions; posterior portion unusually short in proportion to anterior portion; oesophageal and intestinal caeca present. Excretory organ similar to that of *A. osculata*.

Male: 40^{mm} long; tail with 12 pairs of postanal papillae, of which 1 pair is conical and lateral, but varying in position; 1, 2, 3 in a row near the tip; 4 to 12 irregularly arranged in groups of two and three; praeanal papillae in a single row; spicules?

Female: 50^{mm} long; vagina about one-fourth the length of the body from the head; eggs?

Habitat: Intestinal tract of marine mammals.

Host.	Locality.	Collector.	Authority.
<i>Platanista gangetica</i>			Schneider, 1866, p. 44.
<i>Platanista gangetica</i>	Houghly River, near Calcutta	Reinhardt	Krabbe, 1878, p. 47.
<i>Platanista gangetica</i>	Specimens from Copenhagen Museum		Jägerskiöld, 1894, p. 467.

HISTORICAL REVIEW.—For the history of *Ascaris delphini* see page 162. Schneider (1866, p. 44) originally described *Ascaris lobulata* with the following diagnosis:

C. Lippen ohne Zahnleiste mit Aurikeln und Zwischenlippen.

15. *Ascaris lobulata* n. sp. ♂ und ♀ 40mm.

Rinne tief. Die Spitze des Eckzahns bildet einen rechten Winkel. Die Loben reichen in die Auriculæ. Vulva? Schwanz des ♂ leicht gekrümmt, auf der Bauchseite glatt. 12 Papillen hinter dem After, eine an unregelmässiger Stelle mit conisch verlängerter Pulpa seitlich. 1, 2, 3 hinter einander nahe an der Spitze, 4-12 unregelmässig zu 2 und 3 neben einander, vor dem After eine Reihe Papillen.

Delphinus gangeticus. Crassum.

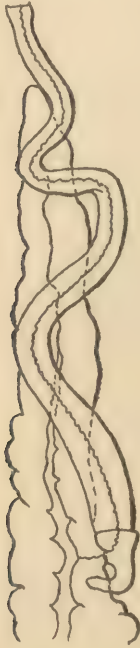


Fig. 91.



Fig. 90.

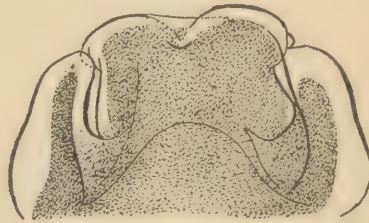


Fig. 92.

Krabbe (1878, p. 47) examined specimens deposited in the museum of the University of Copenhagen; they were collected on the Galathea expedition of Professor Reinhardt from the buccal cavity of dolphins of the Ganges in Hooghly River near Calcutta. The lips (fig. 91) resemble those of *Ascaris osculata*, but are more strongly built.

Jägerskiöld (1894, p. 461) examined specimens from the buccal of *Platanista gangetica*, which he received from Levinsen, of the Copenhagen Zoological Museum. These may possibly have been the same specimens which Krabbe studied, but Jägerskiöld does not state so. He found the vulva 6^{mm} from the head in a female 25^{mm} long. The excretory organ agrees with the same organ in *A. spiculigera* and *A. osculata*; the posterior division of the oesophagus (fig. 92) is unusually short, and possesses a caecum; the intestinal caecum is also present.

Stossich (1896, p. 43) takes his diagnosis from the other authors and evidently did not examine specimens.

III. Data concerning the intermediate lips are wanting.

a. Spicules unequal.

11. *ASCARIS DUSSUMIERII* Beneden, 1870. Sp. inq.

1845, "*Ascaris simplex* RUDOLPHI, 1809" misdetermined, DUJARDIN, 1845, Hist. Nat. Helminthes, pp. 220-221.

? 1860, *Conocephalus typicus* DIESING, see p. 127.

1870, *Ascaris Dussumierii* BENEDEN, Bull. Acad. R. Belgique, 2 ser., XXIX, No. 4, p. 362-363. Dujardin's specimens renamed.

DIAGNOSIS.—Intermediate lips ?; lateral cervical alae absent; head obtuse, 0.4^{mm} broad; lips small, body whitish, quite thick, slightly more attenuated toward the head than toward the tail. Cuticle with cuticular bands 20 to 30 μ broad, giving the margin of the worm a serrate appearance. First portion of the oesophagus 5 to 5.5^{mm} long, 0.5^{mm} broad; followed by a second portion, which is sigmoid, 1.5^{mm} long 0.4^{mm} broad; intestinal and oesophageal caeca ?

Male: 79^{mm} long by 2.2^{mm} in diameter; tail curled, with lateral alae and 8 to 10 (pairs?) papillae; spicules unequal, one 27^{mm} (2.7^{mm}?) the other 15^{mm} (1.5^{mm}?) long.

Female: 70 to 100^{mm} long by 2 to 2.5^{mm} in diameter; tail very short; vulva in anterior half of body 25 to 40^{mm} from anterior end. Eggs globular, smooth, 41 to 43 μ . Anus 0.2^{mm} from tip of tail.

Habitat: Intestine of marine mammals.

Host.	Locality.	Collector.	Authority.
Dolphin (gen. et sp ?).....	West of Maldiv Islands	Dussumier.....	Dujardin, 1845, p. 221.

SUMMARY.—Dujardin (1845) determined some worms, collected by Dussumier, as *Ascaris simplex*; as the form differs essentially from *A. simplex* of other authors van Beneden (1870) proposed to make it a distinct species, *A. Dussumierii*; von Linstow (1888) thinks the worm may belong to some other genus than *Ascaris*; Stossich (1896) considers it identical with *A. simplex*. The question can not be definitely decided without a reexamination of the type specimens, but judging from the description we are suspicious that Dujardin's form is identical with *Ascaris typica*. In detail the history of the species is as follows:

HISTORICAL REVIEW.—Dujardin (1845, pp. 220, 221) proposed the subgenus *Anisakis* in the genus *Ascaris* for forms in which the spicules are unequal. He cites as members of this subgenus *A. distans* Rudolphi, which he had evidently not examined, and the supposed "*A. simplex* Rudolphi" (= *A. Dussumierii*) which he had studied. We designate this latter form as type of the proposed subgenus. Dujardin's diagnosis reads as follows:

ANISAKIS.

III^e Sous-genre.

Mâle ayant deux spicules inégaux.

77 *Ascaride des Dauphins. Ascaris simplex*—RUDOLPHI. Entoz., II, 1, p. 170, et Synops, p. 60 [49], No. 53.

Corps blanchâtre, assez épais, trente-six à quarante fois aussi long que large, un peu plus aminci en avant; tête obtuse, large de 0^{mm}, 4 à trois lobes très-petits; sans aucune trace d'ailes ou membranes latérales; oesophage long de 5 à 5^{mm}, 5, un peu renflé en massue et large de 0^{mm}, 5, suivi d'un ventricule mince flexueux, long de 1^{mm}, 5, large de 0^{mm}, 4; intestin épais, large de 1^{mm}; queue très-courte, obtuse; tégument à stries transverses, très-prononcées, distantes de 0^{mm}, 02 à 0^{mm}, 03, et comme denté en scie latéralement.

Mâle long de 79^{mm}, large de 2^{mm}, 2; partie postérieure enroulée et munie de deux ailes ou membranes latérales, étroites, soutenues par huit à dix papilles à la face ventrale; deux spicules *inegaux*, un peu arqués, larges de 0^{mm}, 04, l'un long de 27^{mm}, l'autre long de 15^{mm}.

Femelle longue de 70 à 100^{mm}, large de 2^{mm}, à 2^{mm}, 5, à queue conoïde très-courte; anus à 0^{mm}, 2 de l'extrémité; vulve située en avant du milieu (à 25 ou 40^{mm} de la tête); utérus très-ample, long de 28 à 30^{mm}, dirigé en arrière, commençant par une partie presque filiforme (vagin), longue de 5 à 8^{mm}, puis devenant cylindrique, large de 1^{mm}, 8, dans une longueur de 10 à 17^{mm}, et se divisant enfin en deux branches parallèles contiguës, larges de 1^{mm}, longues de 7 à 10^{mm}, qui se retrécissent à la fois pour se continuer chacune avec l'oviducte et l'ovaire filiforme correspondant, dont les replis nombreux occupent toute la partie postérieure du corps, à partir de la vulve; œufs globuleux, lisses, larges de 0^{mm}, 041 à 0^{mm}, 043.

Je décris ainsi des helminthes assez nombreux de la collection du Muséum de Paris, étiquetés comme trouvés par M. Dussumier dans un dauphin, no 5, à l'ouest des îles Maldives, en 1830, et je ne doute pas qu'ils ne soient identiques avec ceux que Rudolphi a décrits sous ce même nom comme trouvés dans le premier estomac d'un marsouin (*Delphinus phocaena*).

Van Beneden (1870, pp. 362, 363) did not consider Dujardin's determination as correct, and proposed to call the worms *A. Dussumierii*.

No one appears to have restudied the species or to have found it again, but von Linstow (1888, p. 3) agrees with van Beneden that the determination by Dujardin is incorrect, and he even doubts whether the worm belongs to the genus *Ascaris*. Stossich (1894, p. 17), on the other hand, accepts Dujardin's determination as correct.

In the absence of specimens it is impossible to give a definite opinion upon the form, but we incline to the view that *A. Dussumierii* may perhaps be identical with *A. typica* and that Dujardin made an error in his decimals in the length of the spicules.

b. Unidentifiable forms.

12. ASCARIS DELPHINI Rudolphi, 1819.

1801, "Ascarides" of LEBECK, Neue Schriften Naturforsch. Freunde Berlin, III, p. 281.

1819, *Ascaris delphini* RUDOLPHI, Entozoorum synopsis, pp. 54, 296. Refers to Lebec's specimens.—

DUJARDIN, 1845, Hist. Nat. Helminthes, p. 221.—VAN BENEDEN, 1870, Bull. Acad. Roy. Belgique, 2 ser., XXIX, p. 359.

1851, *Ascaris delphini gangetici* DIESING as synonym sub *A. simplex*, Systema helminthum, II, p. 155.—*Ascaris delphini* Rudolphi, 1819.

?1866, *Ascaris lobulata* SCHNEIDER, see p. 159.

1878, "*Ascaris simplex* Rud.," VON LINSTOW, Compendium der Helminthologie, p. 60, as parasite of *Platanista gangetica*.

DIAGNOSIS.—Over an inch long.

Habitat: Mouth and stomach of dolphin of the Ganges.

Host.	Locality.	Collector.	Authority.
<i>Platanista gangetica</i>	Near Calcutta	Lebeck	Lebeck, 1801, p. 281.

Lebeck (1801, p. 281) found some ascarides in a specimen of "*Delphinus gangeticus*" (= *Platanista gangetica*) taken in November, 1797, near Calcutta. Regarding the parasites he simply states: "Sowohl in seinem Munde als Magen, waren viele lebendige und über einen Zoll lange Ascarides—L. wie auch im letztern Nelly-Körner."

Rudolphi (1819, pp. 54-296) named these worms *Ascaris delphini*, but did not study them; he suspects that they are identical with *Ascaris simplex*. Dujardin (1845, p. 221) simply mentions the worms, while Diesing (1851, p. 155) refers them to *A. simplex* under the trinomial synonym "*Ascaris Delphini gangetici*," while van

Beneden (1870, p. 359) again reverts to "*Ascaris delphini*," citing Lebeck's reference as to the occurrence of parasites in the dolphin of the Ganges *Platanista gangetica* (*Delphinus gangeticus*). Von Linstow (1878, p. 60) cites *Ascaris simplex* as parasite of *Platanista gangetica*, but undoubtedly he refers to the supposed synonym *A. delphini*. Stossich (1896, p. 17) also makes *A. delphini* a synonym of *A. simplex* and cites *Platanista* as host.

It is impossible to identify this worm, but Schneider has described *A. lobulata* from the same host (p. 159), and the two forms may possibly be identical.

13. ASCARIS RYTINAE Diesing, 1851.

1751, "Lumbrici candidi" of STELLER, Nov. Comment. Acad. Sci. Imp. Petropol., II, ad Ann. 1749, p. 311.

1846, "Ascarides" of BRANDT, Bull. Physico-Math. Acad. Imp. Sci. St. Petersbourg, V, p. 192. Refers to Steller's specimens.

1851, *Ascaris rytinae* DIESING, Systema helminthum, II, p. 190. Species inquirenda; refers to Steller and Brandt.

1851, *Ascaris rhytinae Stelleri* in synonymy, DIESING, Systema helminthum, II, p. 190.

1878, "*Ascaris rhytinae* BRANDT," in VON LINSTOW, Compendium der Helminthologie, p. 59.—STOSSICH, 1896, Boll. Soc. adriatica Sci. nat. Trieste, XVII, p. 69.

DIAGNOSIS.—Length 6 inches.

Habitat: Stomach and duodenum of the Northern extinct sea cow.

Host.	Locality.	Collector.	Authority.
<i>Hydrodamalis gigas</i>	Bering Sea.....	Steller.....	Steller, 1751, p. 311.

SUMMARY.—Our entire knowledge of this worm is based upon the statement by Steller (1751) that specimens were present in the stomach and duodenum of the now extinct sea cow. Brandt (1846) thought they must be ascarides since Rüppel and Owen found ascarides in the stomach of the dugong. Diesing named the worm more than a century after Steller found it. The parasite is unidentifiable. In detail the history of the worm is as follows:

HISTORICAL REVIEW.—Steller (1751, p. 311) in his "De bestiis marinis" found some worms of the stomach and duodenum of a sea cow on July 12, 1742, taken in the Bering Sea. He refers to the parasites in the following passage:

Interior ventriculi tunica a lumbricis candidis $\frac{1}{2}$ pedem longis, quibus totus ventriculus, pylorum et duodenum scatebat, perforata erat, et lumbrici in glandulae cauum, vsque penetrauerant, glandula discissa copiosum, succum sundeat. Non licuit posthac plures ventriculos examinare ob id, quod necessario auxilio carebam, nec cum paucis animal semel inuenire iacens in dorsum vertere possem, propterea dubito, an haec glandula res constans, vet potius morbidum quid fuerit.

Brandt (1846, p. 190–192) in referring to the ectoparasites mentioned by Steller (1751, pp. 298, 324, 330), and for which he (Brandt) proposed the genus *Sirenocyamus* and the specific name *S. Rhytinae*, also cites the worms found by Steller; he believed them to be "*Ascarides*," but did not name or describe them. He also refers to the worms found by Rüppel and Owen, but does not name or describe them. Diesing (1851, p. 190) cites "*Ascaris Rhytinae* Brandt" among the *species inquirendae*; the term is practically a *nomen nudum*, the only description being "Longit. $\frac{1}{2}$," and refers to the worms found by Steller in July, 1742; von Linstow (1878, p. 59) mentions the parasites as "*Ascaris rhytinae* Brandt." Stossich (1896, p. 69) also refers to the same worms as a *species inquirenda*, giving the length as 160^{mm}.

As Steller's sea cow is now extinct it can never be demonstrated what species Steller found. The names *A. rytinae* and *A. rhytinae* may, therefore, be buried, and all time used in speculating as to the affinities of this worm with corresponding parasites in other hosts may be considered lost.

14. "ASCARIS CAPSULARIA."

Ascaris capsularia is a name applied to immature nematodes, supposed to be ascarides, and found in fish. Numerous supposed species have been separated under distinct specific names, generally taken from the names of the hosts, the generic names *Agamonema*, *Nematoideum*, or *Ascaris* being used by various authors. Personally, we must confess our inability to distinguish at present these numerous forms from each other or to determine from the published descriptions of the worms which forms should be considered synonyms, which forms should be looked upon as distinct, and which forms should be associated with this, that, or the other adult *Ascaris*. We do not deny that other authors are correct in their interpretations of these larval worms, but we would suggest that a thorough study of the exact food habits of fish-eating mammals in connection with this subject would aid in solving the problem of the life history of many of these parasites.

III.—Family STRONGYLIDAE.

DIAGNOSIS.—Nematoda with body elongate, cylindrical, rarely filiform. Mouth is probably always provided with six papillae, of which the four submedian are generally salient in form of nodules or conical points. In some cases the mouth is in the axis of the body; in others, turned dorsally or ventrally, and occasionally provided with a chitinous armature. Oesophagus more or less swollen in posterior portion, but without forming a distinct oesophageal bulb. Males provided with a caudal bursa, open or closed, entire or divided, with one or two spicules. Females with one or two ovaries; vulva anterior or posterior to middle, in some cases near the anus. Eggs deposited during segmentation, in some cases containing embryo.

Type: *Strongylus*, O. F. Müller.

Subfamily SCLEROSTOMINAE.

DIAGNOSIS.—Strongylidae; meromyaria; mouth with more or less complete chitinous armature. Male with two equal spicules; caudal bursa with rays, the postero-median and postero-external being united in a common base. Female with two ovaries, except in *Ollulanus*.

Type: *Sclerostoma*, Blainville, 1828.

Genus UNCINARIA Frölich, 1789.

1789, *Uncinaria* FRÖLICH, Der Naturforscher, XXIV, pp. 137-139. Type, *Uncinaria vulpis* Frölich, 1789.
1843, *Agchylostoma* DUBINI, Annal. univers. di medic. Milano, CVI, April, pp. 5-13. Type, *Agchylostoma duodenale* Dubini, 1843.

1845, *Ancylostoma* CREPLIN, Archiv. f. Naturg., 11 Jhg., I, p. 325. For *Agchylostoma* Dubini, 1843.

1845, *Dochmius* DUJARDIN, Histoire naturelle d. helminthes, pp. 267-275. Type, *Dochmius trigonocephalus* (Rudolphi, 1809) = *Uncinaria vulpis* Frölich, 1789.

(1846), *Ancylostoma* DELLE CHIAJE Rendicon. dell Accad. delle Sci. Napoli, V, p. 339.

1851, *Ancylostomum* DIESING, Systema helminthum, II, p. 321-322. For *Agchylostoma* Dubini, 1843.

1855, *Ancylostomum* KÜCHENMEISTER, Die in und auf d. Körper d. lebenden Menschen vorkommend. Parasiten, I, p. 297.

1861, *Monodontus* MOLIN [nec *Monodonta* Lamarek, 1799], Il Sottordine degli Acrofalli, pp. 11-43. Type, *M. semicircularis* Molin, 1861.

DIAGNOSIS.—Sclerostominae with anterior extremity curved dorsally; mouth round to oval, opening obliquely, limited by a transparent border and followed by a chitinous buccal capsule; the dorsal portion of the capsule is shorter than the ventral, and is supported by a conical structure the point of which sometimes extends into the cavity; ventral at the base of the buccal capsule are found two

teeth; toward the inner free border the ventral wall bears on each side of the median line chitinous structures or teeth often recurved in shape of hooks; the inner dorsal wall may also bear teeth.

Type, *Uncinaria vulpis* Frölich, 1789.

This is an extremely important genus from a medical standpoint as it contains a parasite (*U. duodenalis*) which causes a serious disease in man, and two parasites (*U. vulpis* and *U. stenocephalus*) which cause serious trouble in young dogs.

Lucas found five specimens of worms of this genus in a 3-months old fur seal which had starved to death.

15. *UNCINARIA* sp.

(Figs. 93-96.)

DIAGNOSIS.—Body white. Buccal capsule apparently with a single pair of rather weak anterior ventral recurved teeth, and with posterior ventral chitinous lamellae.

Male: 6.5^{mm} long; caudal bursa very similar to that of *U. duodenalis*, spicules very slender, equal, 0.5^{mm} long.

Female: 12^{mm} long; tail acuminate; vulva slightly posterior to the middle of the body. Eggs elliptical 124 to 132 μ by 84 to 88 μ .

Habitat: Intestine of fur seal (*Callorhinus ursinus*) Bering Sea. Type: U.S.N.M., No. 2815.

Our material of this form does not permit a detailed study of the mouth, and on this account we hesitate to place the worm specifically.

No other species of *Uncinaria* is known for marine mammals.



Fig. 93. Fig. 94.



Fig. 95.

The few specimens which Lucas collected certainly could have been of no importance in the economy of the host, but as *Uncinaria* is a blood sucker of the worst type, and as allied species produce serious troubles in man and dogs, analogy would imply that a heavy infection of the seal would produce similar troubles in that host. Analogy would also imply that the development of the parasite is direct, without intermediate host, and that a crowded condition of the rookeries would render an epizootic probable. Under these circumstances the worm might play an important rôle in the mortality of the seal pups, more especially if the latter were deprived of food by reason of the killing of their mothers by pelagic sealing.

SUPPLEMENTARY NOTE TO THE *UNCINARIA* OF THE FUR SEAL.

During the season of 1897 Lucas collected a number of specimens of *Uncinaria* from seals, and fully verified the prophecy made above. In connection with the study of the new material, the seal commission has requested us to prepare a monograph of the genus *Uncinaria*, discussing the subject from a medical as well as from a zoological standpoint. This monograph is now in course of preparation, but it is impossible to complete it in time for incorporation in this report, owing to the absence of one of our number from the country.

In compliance with request, we will finish the work later and submit it for publication as a supplement to this present article. We here add only the following very brief summary:

From our studies this far we are inclined to look upon the seal *Uncinaria* as a new species, but are not willing to commit ourselves until further comparison with

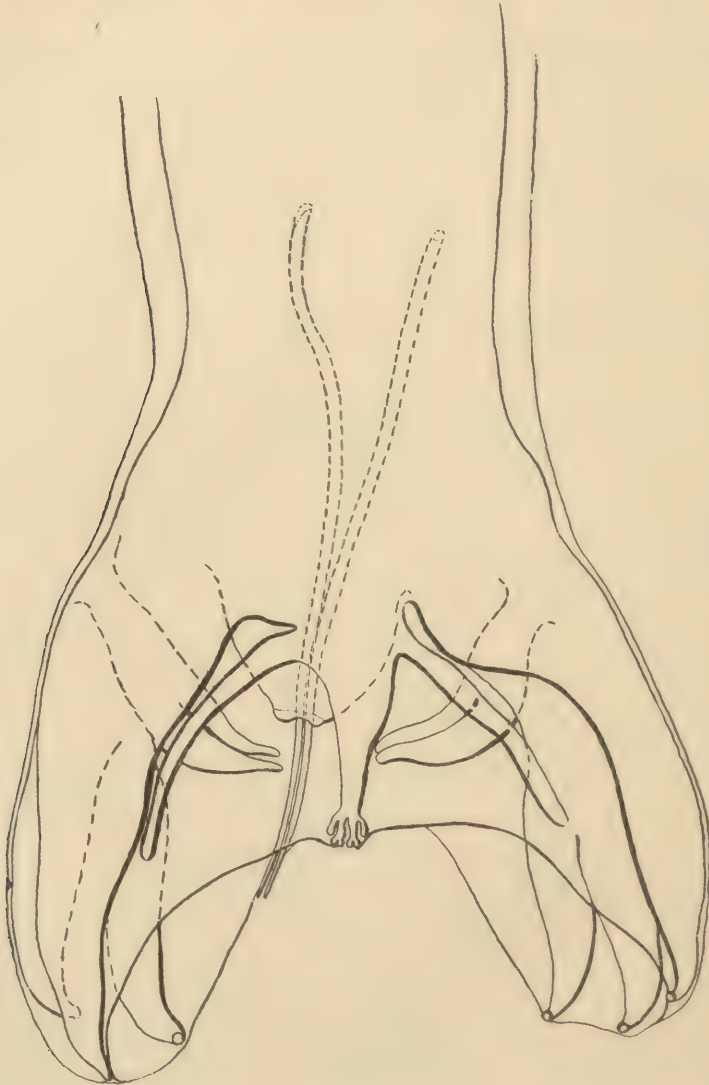


Fig. 96.

types of other species. Should our present view on this point be confirmed by our later study, we shall dedicate the species to its original collector, Mr. F. A. Lucas.

There is at present no reason to assume that the uncinariosis of the seal will differ essentially from the same disease in man, dogs, and cats. The injury to the host caused by worms of this genus results (1) from loss of blood and (2) from the

inability to absorb nourishment, due to the diseased condition of the intestinal mucosa. Whether the parasites produce a specific poison which affects the host is still an open question; the intense inflammation of the small intestine can easily be explained by the wounds produced by the buccal armature.

We at present see no possible outlook either in the line of treatment or prevention, so far as this disease in the seals is concerned. In man thymol is a specific. It is difficult to disinfect against the eggs of the genus.

The symptoms and pathological lesions in various animals will be described in the later paper.¹

LIFE HISTORY.—In the case of two species (*U. vulpis* and *U. duodenalis*) it has been experimentally demonstrated that these worms are autoecious parasites—that is, that they require no intermediate host for their development. The life cycle, which will be given more in detail later, is essentially as follows: The eggs laid by the parasitic females are in the first stages of segmentation; upon being passed with the faeces they develop into a rhabditiform embryo, the time required varying from twelve hours to twelve days or more, according to the conditions of the medium in which they are found, the temperature and the accessibility of air; the eggs find their most favorable conditions in the superficial portion of rather compact faecal matter. The embryos, which measure about 0.3 mm. in length, take nourishment, and after about two or three days undergo the first ecdysis, during which the pointed tail is partially lost. A second ecdysis begins about five to seven days after the escape from the egg, and the worm is soon ready to enter upon its parasitic life; it has lost its rhabditiform character and with its ability to take food during its free life. About five days after entering their host (by means of drinking water or contaminated food) the worms submit to a third ecdysis, during which a provisional buccal capsule is formed. A final (fourth) ecdysis then occurs, four to ten days later, which transforms the parasite into its definite form. About four to five weeks appear to be necessary for the development from the egg to the fully mature stage.

There is no reason to assume that the life history of the seal *Uncinaria* will be materially different from the life history of *U. vulpis* and *U. duodenalis*, but slight variations in the length of the different stages may occur because of the colder climate.

IV.—Family BOTHRIOCEPHALIDAE.

DIAGNOSIS.—Cestoda; head provided with two groove or slit-like suckers; rostellum wanting; uterus with special pore; genital pores generally dorsal or ventral.

Type. *Bothriocephalus* Rudolphi, 1808.

Subfamily BOTHRIOCEPHALINAE.

DIAGNOSIS.—Bothriocephalidae with distinct external segmentation; head with two elongate slit or groove-like suckers.

Type. *Bothriocephalus* Rudolphi, 1808.

Genus BOTHRIOCEPHALUS¹ Rudolphi, 1808, emend. R. Blanchard.

DIAGNOSIS.—Bothriocephalinae with two suckers; penis, vulva, and uterus open ventro-median.

Type. *B. latus*² (Linnaeus, 1758) Bremser.

¹ See pp. 77–82 of this volume, where the subject is discussed by Lucas.

² We fail to see how this generic name can be held for the group to which it is now assigned; certainly *B. latus* can not be taken as the type of *Bothriocephalus*. We refrain from attempting to straighten the synonymy, as a number of names are involved and a proper interpretation of the genera demands a most cautious revision of the entire family.

16. *BOTHRIOCEPHALUS* sp.

(Figs. 97-100.)

In the material collected by Lucas we find several specimens of a *Bothriocephalus* taken from the fur seal. Lucas states that tapeworms were found in about 40 per cent of the seals examined.

To properly place this parasite would require an extensive study of the family Bothriocephalidae, and for this we have not the necessary time at our disposal at



Fig. 97.



Fig. 98.



Fig. 99.

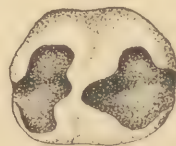


Fig. 100.

present. We will simply remark that analogy would point to the fish as the source of infection by this worm.

The specimens collected by Lucas have been entered in the Helminthological collection of the United States National Museum as Nos. 2765, 2768, 2769, 2817.

V.—COMPENDIUM OF PARASITES, ARRANGED ACCORDING TO THEIR HOSTS.

This compendium covers only the genera *Ascaris*, *Uncinaria*, and *Bothriocephalus*; for all other parasites see von Linstow (1878 and 1889) and van Beneden (1870 and 1889.)

MARINE MAMMALS.

We have personally examined those forms marked with an asterisk (*) under the various hosts. We can not, of course, guarantee the original determinations of the hosts, but taking the determinations given on the labels or by other authors we have corrected the names to those now used in mammalogy. In all cases of doubt we have been guided by the advice of Dr. F. W. True, of the United States National Museum.

270. *BALAENOPTERA ROSTRATA*.*Ascaris simplex*.271. *BALAENOPTERA SIBBALDII* Gray.*Ascaris simplex*.

- 265b. BELUGA LEUCAS see DELPHINAPTERUS LEUCAS.
 CALLORHINUS URSINUS.
** Ascaris decipiens.*
** Uncinaria sp.*
** Bothriocephalus sp.*
- 271b. CLYMENIA see PRODELPHINUS.
197. CYSTOPHORA CRISTATA.
Ascaris decipiens.
Ascaris osculata.
Bothriocephalus anthocephalus.
Bothriocephalus elegans.
Krabbea variabilis (Bothriocephalus variabilis).
- 265b. DELPHINAPTERUS LEUCAS (Pallas).
Ascaris Kükenthalii.
Ascaris simplex.
263. DELPHINUS AMAZONICUS see INIA GEOFFROYI.
257. DELPHINUS DELPHIS Linnaeus.
Ascaris typica.
256. DELPHINUS PHOCAENA see PHOCAENA PHOCAENA.
 DELPHINUS sp.
 DOLPHIN, genus? species? Maldive Islands.
Ascaris Dussumierii.
 DOLPHIN, genus? species?
** Ascaris typica.*
 DOLPHIN, genus? species?
Ascaris simplex.
254. DUGONG DUGON.
Ascaris halicoris.
198. ERIGNATHUS BARBATUS.
** Ascaris decipiens.*
** Ascaris osculata.*
Bothriocephalus anthocephalus.
Bothriocephalus cordatus.
Bothriocephalus hians.
Bothriocephalus lanceolatus.
Krabbea variabilis (Bothriocephalus variabilis).
- EUMETOPIAS STELLERI.
** Ascaris decipiens.*
** Ascaris osculata.*
195. HALICHOERUS GRYPUS.
Ascaris decipiens.
Ascaris osculata.
254. HALICHORE CETACEA see DUGONG DUGON.
254. HALICHORE DUGONG see DUGONG DUGON.
255. HYDRODAMALIS GIGAS. Extinct.
Ascaris rytinae.
266. HYPEROODON ROSTRATUM (Chemnitz).
Ascaris simplex.
263. INIA BOLIVIENSIS, see INIA GEOFFROYI.
263. INIA GEOFFROYI (Desmarest).
Peritrachelius insignis, see p. 107.
- LAGENORHYNCHUS ALBIROSTRIS, Gray.
Ascaris simplex.
196. LEPTONYX MONACHUS see 195a MONACHUS ALBIVENTER.
 MACRORHINUS ANGUSTIROSTRIS.
** Ascaris decipiens.*
253. MANATUS EXUNGUIS see MANATUS INUNGUIS.

253. *MANATUS INUNGUIS*.
Heterocheilus tunicatus see p. 107.
MESOPLODON BIDENS (Sowerby).
Ascaris simplex.
MESOPLODON SOWERBIENSIS, see *MESOPLODON BIDENS*.
- 195a. *MONACHUS ALBIVENTER*.
**Ascaris osculata*.
Bothriocephalus hians.
265. *MONODON MONOCEROS* Linnæus.
Ascaris simplex.
194. *ODOBENUS ROSMARUS*.
Ascaris bicolor.
Ascaris decipiens.
Ascaris osculata.
Bothriocephalus cordatus.
- 203b. *OTARIA JUBATA*.
Ascaris osculata.
Ascaris patagonica.
Ascaris simplex.
200. *PHOCA ANSELLATA* see *PHOCA FOETIDA*.
198. *PHOCA BARBATA* see *ERIGNATHUS BARBATUS*.
197. *PHOCA CRISTATA* see *CYSTOPHORA CRISTATA*.
200. *PHOCA FOETIDA*.
Ascaris decipiens.
Ascaris osculata.
Bothriocephalus hians.
Krabbea fasciata (*Bothriocephalus fasciatus*).
199. *PHOCA GROENLANDICA*.
**Ascaris decipiens*.
Ascaris osculata.
PHOCA GRYPHUS see *HALICHOERUS GRYPHUS*.
- 203a. *PHOCA HISPIDA* see *PHOCA FOETIDA*.
PHOCA LARGHA Pallas.
**Ascaris decipiens*.
PHOCA MONACHUS see *MONACHUS ALBIVENTER*.
201. *PHOCA PANTHERINA* = ?
**Ascaris osculata*.
202. *PHOCA VITULINA*.
**Ascaris decipiens*.
Ascaris osculata.
Bothriocephalus elegans.
Bothriocephalus hians.
Bothriocephalus [or *Krabbea*?] *tetrapterus*.
Krabbia variabilis (*Bothriocephalus variabilis*).
256. *PHOCAENA COMMUNIS* see *PHOCAENA PHOCAENA*.
256. *PHOCAENA PHOCAENA* (Linnæus).
"Ascaris capsularia" in the stomach.
Ascaris simplex.
Bothriocephalus stemmacephalus.
264. *PLATANISTA GANGETICA* (Lebeck).
Ascaris delphini sp. inq.
Ascaris lobulata.
?Ascaris simplex.
PORPOISE, genus?, species?, Chiloe Islands.
Ascaris simplex.

- 271b. PRODELPHINUS sp.
Ascaris typica.
255. RHYTINA STELLERI see HYDRODAMALIS GIGAS.
203. SEAL, genus?, species?, Antarctic.
Ascaris similis.
Bothriocephalus [or *Krabbea*?] *antarcticus*.
- SEALS, genera? species?, Faroe.
Ascaris decipiens.
Ascaris osculata.
- SEALS, genera?, species?, Greenland.
Ascaris decipiens.
Ascaris osculata.
- SEALS, genera?, species?, Iceland.
Ascaris decipiens.
Ascaris osculata.
- STENORHYNCHUS LEPTONYX.
Ascaris osculata.
194. TRICHECHUS ROSMARUS see ODOBENUS ROSMARUS.

FISH.

For the parasites of fish, see von Linstow, 1878 and 1889, and Stossich, 1894.

- GADUS MACROCEPHALUS.
**Ascaris decipiens*.
- POLLACHIUS CHALCOGRAMMUS see THERAGRA CHALCOGRAMMA.
- THERAGRA CHALCOGRAMMA.
**Ascaris decipiens*.

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DESCRIPTION OF FIGURES.

- Fig. 1. Dorsal lip of *Ascaris decipiens*, showing the basal portion, the anterior bilobed projection and the dentigerous ridge. $\times 100$. After Krabbe, 1878, pl. i, fig. 3.
- Fig. 2. Tail of male specimen of *Ascaris decipiens*, ventral view, showing the cloaca, the six pairs of postanal papillae, and some of the praeanal papillae. $\times 100$. After Krabbe, 1878, p. 46, fig. 1.
- Fig. 3. Dissection of a male specimen of *Ascaris bulbosa* ($=A. decipiens$) from *Erignathus barbatus*: "b., bulb of the oesophagus; d., intestine; de., ductus ejaculatorius; eo., excretory organ; h., testicles; mb., bursal muscle; sf., lateral line; sl., vas deferens; ss., vesicula seminalis ("Samenschlauch"). $\times 2$. After Cobb, 1888, pl. v, fig. 29.
- Fig. 4. Ventral view of tail of *Ascaris bulbosa* ($=A. decipiens$) from *Erignathus barbatus*, showing the cloaca and the caudal papillae. $\times 80$. It will be noticed that postanal papillae 5 + 6 are double; otherwise this figure agrees essentially with Krabbe's figure given above (fig. 2). After Cobb, 1888, pl. v, fig. 30.
- Figs. 5 and 6. Two variations of the anterior portion of the intestinal tract of *Ascaris decipiens* from *Halichoerus grypus*. Cf. figs. 16 and 17. Fig. 5 shows the two portions of the oesophagus, the oesophageal caecum, the proximal portion of the intestine and the intestinal caecum. Fig. 6 shows the two portions of the oesophagus without formation of an oesophageal caecum, and the proximal portion of the intestine with intestinal caecum. Zeiss 2/A2. After Jägerskiöld, 1894, pl. XXVIII, figs. 40 and 41.
- Figs. 7 and 8. Two female specimens of *Ascaris decipiens* from the Alaskan fur seal and the hair seal. The transverse ridge on the ventral surface designates the position of the vulva. Natural size. Original.
- Fig. 9. Male specimen of *Ascaris decipiens* from the Alaskan fur seal, showing the curved, flattened tail. Natural size. Original.
- Fig. 10. Transverse section of the head of *Ascaris decipiens* from the Alaskan fur seal, showing three lips with their sense-papillae; the triangular lumen of the oesophagus, with apex extending between the ventral lips. The section is slightly diagonal. Zeiss 4/8, stage. Original.
- Fig. 11. Apex view of the cuticle of the lips of *Ascaris decipiens* from the Alaskan fur seal. The excretory pore is seen between the ventral lips. Zeiss 4/8, stage. Original.
- Fig. 12. Dorsal view of the anterior portion of *Ascaris decipiens* from the Alaskan fur seal, showing the dorsal and ventral lips and the cervical papillae. Zeiss 4/16, stage. Original.
- Fig. 13. Ventral view of the anterior portion of *Ascaris decipiens* from the Alaskan fur seal, showing the ventral lips and cervical papillae. Zeiss 4/16, stage. Original.
- Fig. 14. Apex view of the lips of *Ascaris decipiens* from the Alaskan fur seal, showing the anterior double-lobed projections; the excretory pore is seen between the ventral lips. Free-hand drawing under a magnifying glass. Original.
- Fig. 15. Transverse section through anterior extremity of the lips of *Ascaris decipiens* from the Alaskan fur seal, showing the double-lobed projections with dentigerous ridge. Zeiss 4/4, stage, afterwards reduced one-half. Original.
- Figs. 16, 17. Two views of the proximal portion of the intestinal tract of *Ascaris decipiens* from the Alaskan fur seal. Cf. figs 5 and 6. Zeiss 4/a*10, stage, afterwards reduced one-half.
- Fig. 18. Lateral view of tail of male of *Ascaris decipiens* from the Alaskan fur seal, showing carinated dorsal ridge, lateral alae, concave ventral surface, sense papillae, and spicules. Zeiss 4/16, stage. Original.
- Fig. 19. Ventral view of tail of male of *Ascaris decipiens* from the Alaskan fur seal, showing somewhat the swollen lateral alae, the cloaca, and sense papillae. Original.

- Fig. 20. A young *Ascaris* found in the stomach of the Alaskan fur seal, and corresponding to "*A. cap-sularia*." Zeiss 4/a*10, stage, afterwards reduced one-third. Original.
- Fig. 21. Anterior extremity of same. Zeiss 4/8, stage, afterwards reduced one-third. Original.
- Fig. 22. Posterior extremity of same. Zeiss 4/8, stage, afterwards reduced one-third. Original.
- Fig. 23. Dorsal lip of *Ascaris simplex*, showing basal portion with bilobed anterior projection and dentigerous ridge. After Krabbe, 1878, pl. I, fig. 4.
- Fig. 24. Ventral view of tail of male specimen of *Ascaris simplex*, showing cloaca and sense papillae. The postanal papillae are divided into two groups; four pairs of conical papillae near the tip; one and a half pairs of sessile papillae near the cloaca; the praeanal papillae near the cloaca are less prominent than those situated further cephalad. x 100. After Krabbe, 1878, p. 48, fig. 2.
- Fig. 25. *Ascaris simplex* from *Otaria jubata*. Natural size. After von Linstow, 1888, pl. I, fig. 1.
- Fig. 26. Dorsal view of dorsal lip of *Ascaris simplex* from *Otaria jubata*. After von Linstow, 1888, pl. I, fig. 2.
- Fig. 27. Apex view of lips of *Ascaris simplex* from *Otaria jubata*: a., upper lip; b., mouth; c., ventral lip. After von Linstow, 1888, pl. I, fig. 3.
- Fig. 28. Egg of *Ascaris simplex* from *Otaria jubata*. After von Linstow, 1888, pl. I, fig. 4.
- Fig. 29. Proximal end of intestinal tract of *Ascaris simplex* from *Balaenoptera sibbaldii*, showing two divisions of the oesophagus and proximal end of the intestine. Zeiss 2/A*2. After Jügerskiöld, 1894, pl. XXVIII, fig. 42.
- Fig. 30. One of Diesing's original figures of "*Conocephalus typicus*" (= *Ascaris typica*). The drawing shows a partially dissected female, with the umbrella-like structure on the head which was mistaken for a generic character; the intestine and one of the longitudinal lines are visible in the body cavity; the vulva is distal to the middle of the body; an error has undoubtedly been made in the original drawing in the structure of the genital tract, since the vagina and body of the uterus should be comparatively short. After Diesing, 1860, fig. 10.
- Fig. 31. Dorsal lip of "*Ascaris conocephalus*" (= *Ascaris typica*), showing the structures described in the text. x 100. After Krabbe, 1878, pl. I, fig. 5.
- Fig. 32. Ventral view of tail of male specimen of "*Ascaris conocephalus*" (= *Ascaris typica*), showing the caudal papillae as described by Krabbe. x 100. After Krabbe, 1878, p. 50, fig. 3.
- Fig. 33. Ventral view of dorsal lip of "*Peritrachelius typicus*" (= *Ascaris typica*), showing the structure described in the text. x 125. After Drasche, 1883, pl. III, fig. 6.
- Fig. 34. Dorsal view of dorsal lip of "*Peritrachelius typicus*" (= *Ascaris typica*), showing the structures described in the text. x 125. After Drasche, 1883, pl. III, fig. 7.
- Fig. 35. Inner surface of ventro-lateral lip of "*Peritrachelius typicus*" (= *Ascaris typica*), showing the structure described in the text. x 280. After Drasche, 1883, pl. III, fig. 1.
- Fig. 36. Inner surface of right ventro-lateral lip of "*Peritrachelius typicus*" (= *Ascaris typica*), showing the structure described in the text. x 280. After Drasche, 1883, pl. III, fig. 2.
- Fig. 37. Apex view of lips and mouth of "*Peritrachelius typicus*" (= *Ascaris typica*), showing the relative position of the lips and the absence of intermediate lips. x 125. After Drasche, 1883, pl. III, fig. 5.
- Fig. 38. Ventral view of tail of male specimen of "*Peritrachelius typicus*" (= *Ascaris typica*), showing the cloaca and caudal papillae as seen by Drasche. x 60. After Drasche, 1883, pl. III, fig. 9.
- Fig. 39. Male specimen of *Ascaris typica* from Leidy's collection (U.S.N.M., No. 5015) determined by Leidy as "*Ascaris simplex*." Natural size. Original.
- Fig. 40. Female specimen of *Ascaris typica* from U.S.N.M., No. 5015. Natural size. Original.
- Fig. 41. Dorsal view of anterior portion of *Ascaris typica* from U.S.N.M., No. 5015, showing dorsal lip, ventro-lateral lips, and cervical papillae. Zeiss 4/16, stage. Original.
- Fig. 42. Ventral view of anterior portion of *Ascaris typica* from U.S.N.M., No. 5015, showing ventral lips and cervical papillae. Zeiss 4/16, stage. Original.
- Fig. 43. Apex view of isolated cuticle of lips of *Ascaris typica* from U.S.N.M., No. 5015, showing general form of lips and the dentigerous ridge. The cuticle of the dorsal lip is somewhat misplaced. Zeiss 4/4, stage, afterwards reduced one-half. Original.

- Fig. 44. Oesophagus of *Ascaris typica* from U.S.N.M., No. 5015, divided into an anterior straight portion and a posterior sigmoid portion. Intestinal and oesophageal caeca are absent. Zeiss 4/a*₁₀. Original.
- Fig. 45. Lateral view of tail of male of *Ascaris typica* from U.S.N.M., No. 5015, to show the structures described in the text. Zeiss 4/16, stage. Original.
- Figs. 46-47. Ventral view of the tails of two male specimens of *Ascaris simplex* from U.S.N.M., No. 5015, showing the unequal spicules and variations in the position of the caudal papillae. Zeiss 4/16, stage. Original.
- Fig. 48. Eggs of *Ascaris simplex* from U.S.N.M., No. 5015, in various stages of segmentation. Zeiss 4/4, stage. Original.
- Fig. 49. A young specimen of *Ascaris typica* from U.S.N.M., No. 5015, partially surrounded by its larval cuticle. Zeiss 4/a*₁₀.
- Fig. 50. Anterior extremity of a young specimen of *Ascaris typica* which has cast part of its larval cuticle. Zeiss 4/8, stage. Original.
- Fig. 51. Caudal extremity of a young specimen of *Ascaris typica* before the larval cuticle has been cast. Zeiss 4/8, stage. Original.
- Figs. 52-56 are given in text.
- Fig. 57. Dorsal lip of *Ascaris patagonica*, showing the double dentigerous ridge and other structures given in the diagnosis. After von Linstow, 1880, pl. III, fig. 1.
- Fig. 58. Male of *Ascaris Kükenthalii*. Natural size. After Cobb, 1888, pl. III, fig. 1.
- Fig. 59. Male of *Ascaris Kükenthalii*, opened on the left side to show the anatomy: *b.*, bulbus of the oesophagus; *de.*, "end portion of the intestine" (or ductus ejaculatorius?); *ed.*, rectum; *eo.*, excretory organ; *h.*, testicle; *kmd.*, smaller portion of the intestine; *l.*, glandular organ; *m.*, mouth; *mb.*, bursal muscles; *md.*, intestine; *m_{sp.}*, muscles of a spicule; *oe.*, oesophagus; *sl.*, vas deferens; *sp.*, spicules; *ss.*, vesicula seminalis ("Samenschlauch"). After Cobb, 1888, pl. III, fig. 7.
- Fig. 60. Tail of male of *Ascaris Kükenthalii*, opened ventrally to show the anatomy: *a.*, anus; *de.*, ductus ejaculatorius; *d_{lm.}*, dorsal longitudinal muscle; *ed.*, rectum; *h.*, testicle; *mb.*, bursal muscle; *sf.*, lateral line; *sf_{b.}*, broadened portion of lateral line; *sl.*, vas deferens; *sp.*, spicules; *ss.*, vesicula seminalis ("Samenschlauch"). x 2. After Cobb, 1888, pl. III, fig. 5.
- Fig. 61. Ventral view of tail of male of *Ascaris Kükenthalii*, showing the cloaca and caudal papillae as seen by Cobb. After Cobb, 1888, pl. III, fig. 3.
- Fig. 62. Apex view of head, showing the position of the lips: *pe.*, excretory pore. x 50. After Cobb, 1888, pl. III, fig. 11.
- Fig. 63. Female specimen of *Ascaris Kükenthalii*. Natural size. After Cobb, 1888, pl. III, fig. 2.
- Fig. 64. Anterior extremity of *Ascaris Kükenthalii*, opened ventrally to show the anatomy: *ag.*, terminal duct of excretory organ; *eo.*, excretory organ; *esf.*, constriction of lateral field; *geo.*, duct of excretory organ; *m.*, mouth; *md.*, intestine; *nr.*, neural ring; *om.*, muscle; *rn.*, dorsal nerve; *sf.*, lateral line. x 2. After Cobb, 1888, pl. III, fig. 4.
- Fig. 65. *Ascaris similis*, natural size, after Baird, 1853, pl. I, fig. 1a. Baird states that this is a male, but it is more probably a female.
- Fig. 66. Head of male, magnified, showing three lips; intermediate lips are absent. After Baird, 1853, pl. I, fig. 1d. After Baird, 1853, pl. I, fig. 1b.
- Fig. 67. *Ascaris similis*, natural size, after Baird, 1853, pl. I, fig. 1c. Baird states that this is a female, but it is more probably a male.
- Fig. 68. Head of female, magnified, after Baird, 1853, pl. I, fig. 1d.
- Fig. 69. Tail of female, magnified, after Baird, 1853, pl. I, fig. 1e.
- Fig. 70. *Ascaris halicoris*, after Baird, 1859, pl. LVI, fig. 2.
- Fig. 71. Head of *Ascaris halicoris*, showing the three lips; intermediate lips are absent. After Baird, 1859, pl. LVI, fig. 2a.
- Fig. 72. Tail of *Ascaris halicoris*, after Baird, 1859, pl. LVI, fig. 2b.
- Fig. 73. Anterior portion of *Ascaris halicoris*, dissected to show the oesophagus, intestine, intestinal caecum, and a portion of the genital organs. After Baird, 1859, pl. LVI, fig. 2c.
- Fig. 74. Transverse section of head of *Ascaris halicoris*, showing the relative position of the three lips and the absence of intermediate lips. After Parona, 1889, pl. XIII, fig. 3.

- Fig. 75. Ventral view of tail of *Ascaris halicoris*, after Parona, 1889, p. 760, fig. 2.
- Fig. 76. Tail of male of *Ascaris osculata* from *Phoca groenlandica*, showing cloaca and caudal papillae. Ventral view. $\times 90$. After Schneider, 1866, p. 44.
- Fig. 77. Inner view of dorsal lip of *Ascaris osculata* from *Phoca groenlandica*; the intermediate lips are not figured. $\times 90$. After Schneider, 1866, pl. I, fig. 13.
- Fig. 78. Dorsal lip of *Ascaris osculata*, showing intermediate lips. $\times 100$. After Krabbe, 1878, pl. I, fig. 1.
- Fig. 79. Dorsal view of anterior end of *Ascaris osculata* from *Stenorhynchus leptonyx*, showing: *rl.*, dorsal lip; *vll.*, ventro-lateral lip; *nl.*, intermediate lip; the folds of the cuticle near the lips are visible. After von Linstow, 1892, pl. II, fig. 11.
- Fig. 80. Transverse section of lips near the base, showing the relative position of lips and intermediate lips of *Ascaris osculata* from *Stenorhynchus leptonyx*. After von Linstow, 1892, pl. II, fig. 14.
- Fig. 81. Transverse section of same near the apex. After von Linstow, 1892, pl. II, fig. 15.
- Fig. 82. Ventral view of tail of male of *Ascaris osculata* from *Stenorhynchus leptonyx*, showing lateral caudal alae, caudal papillae, and two spicules. After von Linstow, 1892, pl. II, fig. 16.
- Fig. 83. Oesophagus of *Ascaris osculata* from *Phoca vitulina*. Zeiss 2/A₂. After Jügerskiöld, 1894, pl. XXVIII, fig. 38.
- Fig. 84. Male of *Ascaris osculata* from *Eumetopias Stelleri*. Natural size. Original.
- Fig. 85. Female *Ascaris osculata* from *Eumetopias Stelleri*. Natural size. Original.
- Figs. 86 and 87. Dorsal (fig. 86) and ventral (fig. 87) views of anterior extremity of female *Ascaris osculata* (U.S.N.M., No. 2767) from *Eumetopias Stelleri*. Zeiss 4/16, stage. Original.
- Fig. 88. Margin of anterior extremity of *Ascaris osculata* from *Eumetopias Stelleri*, to show the peculiar cuticular folds. Zeiss 4/8, stage. Original.
- Fig. 89. Ventral view, tail of male of *Ascaris osculata* (U.S.N.M., No. 2766) *Eumetopias Stelleri*, showing narrow lateral alae, caudal papillae, and cloaca. Original.
- Fig. 90. Ventral view, tail of male of *Ascaris lobulata* from *Platanista gangetica*, showing cloaca and caudal papillae. $\times 90$. After Schneider, 1866, p. 44.
- Fig. 91. Dorsal lip, inner surface, of *Ascaris lobulata*, from *Platanista gangetica*. $\times 100$. After Krabbe, 1878, pl. I, fig. 2.
- Fig. 92. Oesophagus and anterior portion of intestine of *Ascaris lobulata*, showing the long anterior portion of the oesophagus, the short posterior portion with oesophageal caecum, and the intestine with intestinal caecum. Zeiss 2/A₂, extended tube. After Jügerskiöld, 1894, pl. XXVIII, fig. 37.
- Fig. 93. Adult male *Uncinaria* sp. from the intestine of an Alaskan fur-seal pup, U.S.N.M., No. 2815. Natural size. Original.
- Fig. 94. Adult female *Uncinaria* sp. from the intestine of an Alaskan fur-seal pup, U.S.N.M., No. 2815. Natural size. Original.
- Fig. 95. Anterior end of *Uncinaria* sp., U.S.N.M., No. 2815, showing the mouth, buccal capsule, and oesophagus. Zeiss 4/16, stage. Original.
- Fig. 96. Dorsal view of caudal extremity of fig. 93, showing the bursa with its rays, and the two spicules. Zeiss 4/8, stage. Original.
- Fig. 97. *Bothriocephalus* sp., U.S.N.M., No. 2768, from the intestine of the Alaskan fur seal. Natural size. Original.
- Figs. 98-100. Head of same, enlarged. Zeiss 4/a*₁₀, stage. Original.

